Guidelines for the use of ionizing radiation

Controlled areas :

Activity restrictions for the different laboratories are each nuclide-specific and are defined in the Radiological Protection Ordinance (RPO, CC 814.501). Thus, each nuclide has a specific licensing limit (LA) which determines the value of activity (in becquerel, Bq) from which its handling is subject to authorization.

DEFINITIONS :

(Physical) activity of a radioactive source: disintegration speed of the radioactive material constituting the source. Number of radioactive atoms disintegrating per unit of time. The unit of measure of the activity of a radioactive source is the becquerel (Bq), defined as a disintegration per second.

Licensing limit (LA): activity (or activity value) limit above which the handling of a nuclide is subject to authorization. These values are listed in annex III of the Radiological Protection Ordinance (RPO, CC 814.501).

As a general rule, the limits authorized for the different laboratories are multiples of the authorization limit of the nuclide in a normal laboratory:

- Normal laboratory: < LA (not subject to authorization)
- Laboratory C: activity representing 1 to 100 times the licensing limit (LA)
- Laboratory B: activity representing 1 to 10'000 times the licensing limit (LA)

Below a certain activity, called clearance limit (LL), defined by the Radiological Protection Ordinance, a radionuclide is no longer considered radioactive and therefore is not subject to authorization anymore.

Admissible dosages :

External irradiation of people professionally exposed to radiation shall be measured by a recognized personal dosimetry service (CHUV's Institut de Radiophysique, IRA, within UNIL). IRA's dosimetry service offers dosimeters' rental and analysis solution.

Institut de radiophysique
CHUV
Rue du Grand-Pré 1
CH - 1007 Lausanne
Suisse
Phone +41 21 314 82 97

The Radiological Protection Ordinance (RPO) defines limit values relating to the annual dosage and dosage rate. The main limit values are as follows (RPO, art. 22 and 56):

- 1 mSv per year for people exposed to radiation under circumstances not related to the exercise of their profession

- 20 mSv per year for people exposed to radiation within the exercise of their profession (except in special cases)

Should it not be possible to prevent a large amount of radiation exposure, it is necessary to respect the limit values by accordingly reducing the time of presence near the facilities.

Pregnant women :

Article 57 of the Radiological Protection Ordinance (RPO) stipulates the following rules about exposure of pregnant women to radiation (ionizing and non-ionizing):

« Pregnant women may only be deployed as occupationally exposed persons if it is assured that, from the time when a pregnancy becomes known until its completion, the effective dose to the unborn child does not exceed 1 mSv »

Article 53 also specifies that *breastfeeding women must not perform any work with radioactive material involving an increased risk of intakes..*

GUIDELINES FOR YOUNG WORKERS :

Concerning the work of young people, the RPO specifies the following points:

Art. 53 : *Persons aged under 16 years must not be occupationally exposed.*

Art. 57 : *For persons aged 16-18 years, the effective dose must not exceed the limit of 6 mSv per calendar year*

Protection measures against ionizing radiation :

It is compulsory that these protection measures are known before handling any radionuclide!

Access to laboratories using ionizing radiation

Access to class C laboratory is prohibited to unauthorized persons

Students may access these laboratories and carry out operations only in the presence of a graduate assistant

ORGANIZING THE HANDLING OPERATION :

In order to protect themselves from the risk associated with radioactivity, the following procedure should be carried out before starting any operation:

1) In the first place, it is necessary to know the properties of the radionuclide in question:
   - Type of radiation (α, β, γ, X)
   - Radiation energy
   - Half-life
   - Volatility
   - …

2) Before starting work, contact an expert in radiation protection (of the Department, of the faculty or of Service UniSEP) in order to inquire about potential risks and to define appropriate safety measures.

3) Minimize as much as possible exposure time:
   - Test the procedure without the radionuclide
   - Manage and plan the operation
   - Frequently remove radioactive waste from the laboratory
   - Handle radionuclides in due time, with no rush
   - For sealed sources, check the integrity of the lead casing (protection), then make sure that the container is sealed once they have been locked in again. Keep the sources in their storage (closed, under controlled access)

   The shorter the exposure to a radiation field is, the less the dosage received is significant:

$$\textbf{Dose} = \textbf{Dose rate} \times \textbf{Time}$$

STAND AS FAR AWAY AS POSSIBLE FROM THE SOURCE OF RADIATION :

Indeed, for the most part of γ and X radiation, the dosage rate (i.e., the dosage absorbed per unit of time) varies according to the inverse square of the distance, i.e.:

$$\textbf{Dose rate} \propto \frac{\mathbf{1}}{\textbf{Distance}^{\mathbf{2}}}$$

Thus, by doubling the distance between the source and the user, exposure will be divided by 4 over the same duration.

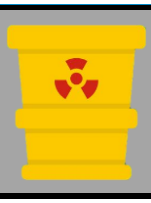
HAVE A SHIELD AROUND THE SOURCE OF RADIATION :

The type of technical protective equipment (sometimes also called collective protection equipment) must be adapted to the type of radiation:

- β radiation: 1.5 cm Plexiglas, wood, light metal (e.g.: aluminum)
- γ and X radiation: lead screen. The effectiveness of a shielding must be assessed using a detector (which has to remain available in a C lab)

NOTES ON THE PROTECTION SHIELD AROUND THE RADIOACTIVE SOURCE :

α Although α radiation is less penetrating (stopped by a simple sheet of paper, for example), it is still very dangerous in the event of incorporation (ingestion)!



Always remember to be protected also from the radiation of radioactive waste!

Working areas :

Radioactive substances are allowed only within defined working areas dedicated to this purpose

Such working areas shall be designed so as to facilitate containment, cleaning and decontamination

The ionizing radiation danger symbol must be clearly visibly placed on suction hoods, lab-desks and refrigerators.

Ensure to limit the quantities of radionuclides used and stored

Handling of radionuclides :

As a general rule, the watchword during the handling of radionuclide is to keep the level of exposure to radiation as low as reasonably possible (according to art. 9 RPA and art. 4 RPO). Measures to limit emissions to a minimum include:

- Use protective devices! As a priority, set up technical protection equipment (screens, shields, etc.) and, secondly, be equipped with the mandatory PPE!

In addition to wearing coat, gloves and safety glasses, a screen protection as well as a dosimeter is mandatory during the handling of radionuclides. Indeed, the dosimeter is necessary for the assessment of the operator's average exposure. It must be carried on the coat at the height of the chest with the sensitive side outward.

- Reduce as much as possible the activity of radioactive sources as well as the power of the equipment.
- Maximize the distance from the source of emission of ionizing radiation. Ensure compliance with the defined safety distances or that access to the hazardous area is impossible.
- Reduce the length of presence near the facilities to a minimum. As a general rule, it is recommended not to remain unnecessarily in a laboratory using radionuclides.
- Prevent any penetration (incorporation) of radiation into the body by inhalation, ingestion and through skin absorption. Direct contact of hands with containers containing radioactive substances must be limited to what is strictly necessary.

- All operations with an associated risk of contamination shall take place on an absorbent paper surface.

- Mark with the radioactivity symbol any container, source or radioactive waste also indicating the nature of the (isotope) radionuclide, its activity, the date as well as the name or contact of the person who packaged these materials.

  For waste, calculate and indicate the date of disposal

- For transport and storage, use properly shielded containers.

- During the operation, let the radioactivity detector turned on and make frequent checks for contamination (including hands).

- Carry out a check for contamination of the working area surface, before and after handling (including a check of clothes and hands). It is imperative to check for contamination before leaving the laboratory.

- At the end of each operation, the objects must be checked and if necessary cleaned up or reported. Any object coming out of the lab contamination must be checked for contamination. Contaminated objects must not come out of the lab.

- Ensure to have the entire surface and the equipment cleaned after handling. No radioactive liquid must be disposed in sinks, except washing water (when activity is below the clearance limit LL).

- For sealed sources, their lead protection must be taken away only for the time strictly necessary to carry out the work.

Sources and links for more information :

LEGAL BASES :

- Radiological Protection Act (RPA, CC 814.50)
- Radiological Protection Ordinance (RPO, CC 814.501)
- FDHA Ordinance on radioactive materials (OUMR in French, CC 814.554)
- FDHA Ordinance on radiation protection applicable to radiological systems for medical use (OrX in French, CC 814.542.1)
- FDHA Ordinance on Order of the DFI on individual dosimetry and environmental dosimetry (in French, CC 814.501.43)
- FDHA Ordinance on Order of the DFI on training, continuing training and activities permitted in relation to radiation protection (in French, CC 814.501.261)
- FDHA Ordinance on Order of the DFI on radioactive waste subject to delivery requirement (in French, CC 814.557)
- FDHA Ordinance on the use of sealed radioactive sources in medicine (OSRM in French, CC 814.501.512)

SUVA Documents :

- « Installations à rayons X et unités d'irradiation en service mobile. Mesures de sécurité, comportement en cas d'incidents » (in French, réf. 66030)
- « Instruments de mesure de radioprotection : exigences et contrôles » (in French, réf. 66093)
- « Attention: contrôle radiographique industriel! » (in French, réf. 84031)
- « Radon dans les installations d'alimentation d'eau. Comment protéger les collaborateurs » (in French, réf. 44097)
- « La radioactivité des débris métalliques ne constitue pas l'exception » (in French, réf. 66129)
- « Locaux d'irradiation pour les essais non destructifs. Mesures au niveau du bâtiment, systèmes de sécurité, contrôles » (in French, réf. 66067)
- « Les irradiations accidentelles (Médecine du travail) » (in French, réf. 2869/21)

Other sources of information :

- « Rayonnement ionisants. Ce qu'il faut retenir » (In French, INRS website, www.inrs.fr)

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