CNRS – IN2P3 – UNIVERSITÉ PARIS - SACLAY – UNIVERSITÉ DE PARIS
Laboratoire de Physique de 2 Infinis Irène Joliot-Curie – 91406 ORSAY Cedex
SERVICE PRÉVENTION DES RISQUES
Tél : 01 69 15 71 33 Mail : spr@ijclab.in2p3.fr

Réf : SPR/Notice_Radioprotection_Accusé_Réception_ENG_v1/30-12-2020

Subject: Acknowledgement of information notice on radiation protection

In accordance with the French regulations you are in possession of an individual notice concerning all the presents risks of ionizing radiation at IJCLab Orsay.

It is up to you to take knowledge of this document. It will serve you as an efficient memento guide during your stay at IJCLab.

Do not hesitate to contact us with your comments or remarks in order to improve our document. It will be available on the intranet web page of the SPR: (https://intranet.ijclab.in2p3.fr/spr/)

We are available to answer all your questions regarding this document or your activities with ionizing radiation at IJCLab.

To contact the radiation safety advisers at IJCLab Orsay, you can dial **01 69 15 71 33** or write us at ***radiopro@ijclab.in2p3.fr***

The names of all the members of the SPR are available on the IJCLab intranet web page.

The following part of this document must be completed and returned to us at:

Service Prévention des Risques
Bâtiment 102C

✂

I undersigned.....(surname, name),

Member of (group, service) .....,

Declare having received and taken knowledge of the following document: *Radiation Safety Guide*

At..... , Date.....

Signature:

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RADIATION SAFETY GUIDE

N°	Rédaction		Vérification		Approbation	
1	Par	Date	Par	Date	Par	Date
	A. DINKOV	*30/06/2021*	*S. WURTH*	*27/08/2021*	*S.WURTH*	*01/09/2021*
	Visa :		Visa :		Visa :	

Réf. : SPR\NOTICE_RADIOPROTECTION_ANG_VERSION_1 du 30-06-2021

TABLE OF CONTENT

0. Introduction

This document serves as information notice, initial training, and three-year retraining for workers exposed to ionizing radiation. It is given to all personnel who must enter a restricted area or a laboratory where there is a risk of exposure to ionizing radiation. Anyone who has to enter such an area to perform regular work must have a medical examination for assessing their fitness carried out by a competent doctor. This visit normally results into a certificate of no contraindication to work that may expose to ionizing radiation.

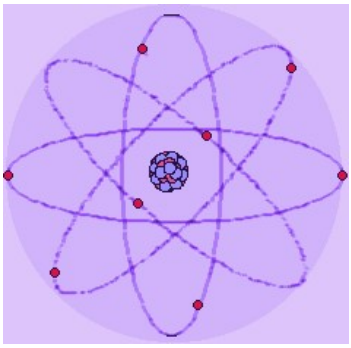
The organization of radiation protection is based on the **ALARA** principle: ***A**s **L**ow **A**s **R**easonably **A**chievable*. This is reflected in particular by:

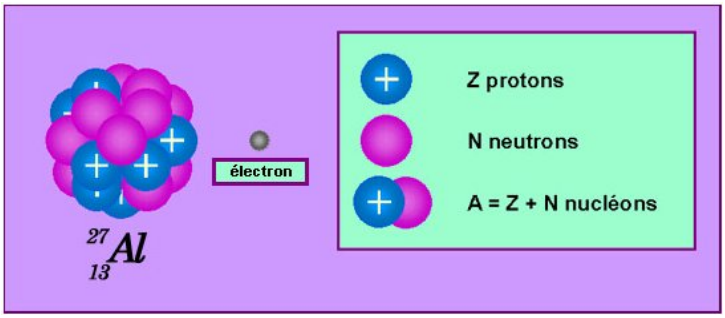
- The person in charge must justify the intervention (experience), and avoid unnecessary doses.
- The scientist must implement the best working methods and principles (preparation, tools, protections) to optimize the intervention.
- Radiation protection must set the individual and collective radiological limits to lower the doses.

1. General definitions

1.1 Physics basics

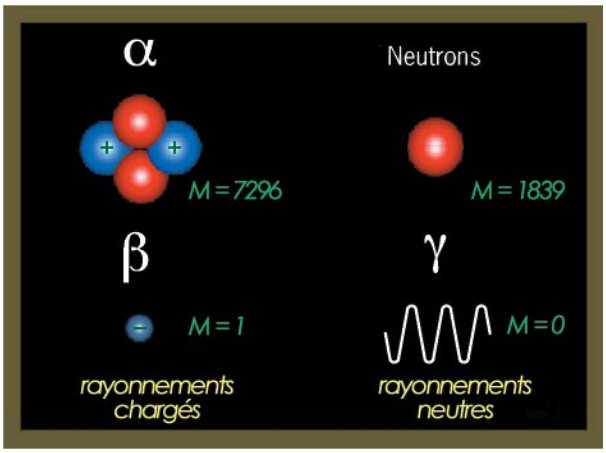
- An atom is composed of a nucleus and an electronic cloud (left image below);
- A nucleus is composed of Z protons, N neutrons, that is A = N + Z nucleons (right image below);
- Proton is positively charged;
- Neutron is neutral (no electric charge);
- Electron is negatively charged (the exact opposite charge from that of the proton);
- An electrically stable atom has as many protons as electrons; otherwise it is an ion (positive or negative).





Some natural or artificial nuclei are unstable. They constantly disintegrate, emitting various types of radiation: this is the physical phenomenon of radioactivity.

- The main types of radiation are:
  - ➢ The alpha and beta radiation are directly ionizing.
  - ➢ Photon (gamma and X) and neutron radiations are indirectly ionizing.



- Three terms are recurrent in this document:
  - Radiation protection: all the means used to protect against ionizing radiation;
  - Radiation: mode of propagation of energy in the form of waves and particles;
  - Ionizing / Ionization: transformation of an atom or a neutral molecule into an ion (negatively or positively charged).

1.2 Total activity

This involves quantifying how radioactive is the item being measured. The activity follows a decreasing exponential law over time. The radioactive half-life (Tr) is introduced, the time after which the number of radioactive nuclei (or the activity) has halved (see paragraph 1.7).

The activity is given in becquerels (Bq): 1 Bq = 1 decay per second.
Ancient unit: curie (Ci), 1 Ci = 37 GBq (37 billions of becquerels).

The activity, noted with A, can be estimated with:

$$A(t) = \frac{A(t=0)}{2^{\frac{t}{T_r}}}$$

A(t): activity over time t,
A(t = 0): initial activity,
t: time interval between initial moment and moment « t ».

1.3 Absorbed dose

The absorbed dose measures the amount of energy received per unit mass.

The unit is gray (Gy), 1 Gy = 1 J / kg (joule/kilogram).
Ancient unit: 1 rad = 0,01 Gy (1 hundredth of gray).

The absorbed dose is noted with D has physical sense.

1.4 Equivalent dose

The equivalent dose measures the dose absorbed by humans on a particular organ or tissue.

The unit is sievert (Sv).
Ancient unit: 1 rem = 0,01 Sv (1 hundredth of sievert).

The equivalent dose, noted with H, has biological sense.

It accounts for the harmfulness of radiation. Depending on the type of radiation reaching the organ or tissue, the equivalent dose will not be the same. The biological weighting factor is introduced to switch from the absorbed dose to the equivalent dose.

$$H = \omega_r * D$$

1.5 Effective dose

The effective dose is given for the whole body.

The unit is also sievert (Sv).

The effective dose, noted with E, has biological sense.

This is the sum of the weighted equivalent doses delivered to different tissues and organs. The tissue weighting factor is introduced, accounting for the radiosensitivity of each tissue or organ.

$$E = \sum_t \omega_t * H_t = \sum_t \omega_t \sum_r \omega_r * D_{t,r}$$

1.6 Sealed and unsealed (opened) sources

Sealed source: Source consisting of radioactive substance solidly incorporated in an inactive solid substance or sealed in an inactive envelope with sufficient strength to avoid, under normal conditions of use, any dispersion of radioactive substance;

Unsealed source: Source other than a sealed source (powder, liquid, or other that may disperse).

1.7 Radiological, biological and effective period

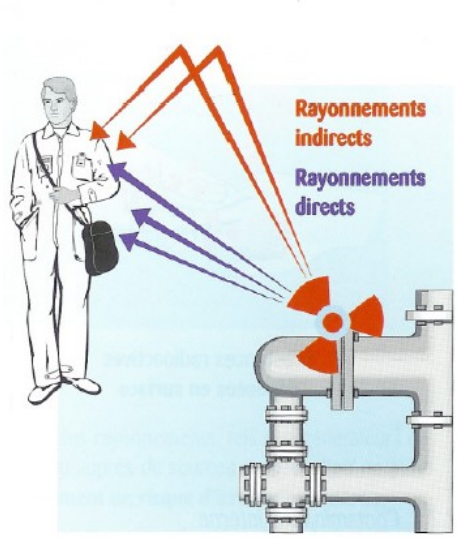
- Radiological period (Tr): Time after which half of the nuclei have disintegrated;
- Biological period (Tb): Time required for the elimination of half the quantity of the radionuclide introduced into the body;
- Effective period (Te): Time of disappearance of the radioactive product. It is a combination of radioactive and biological half-life. → $\frac{1}{T_e} = \frac{1}{T_r} + \frac{1}{T_b}$

2. Risks origins

There are two types of exposure:

- **External**: when the source of ionizing radiation is located **outside** the body;
- **Internal**: when the source of ionizing radiation is located **inside** the body.

2.1. External irradiation



There is "external irradiation" whenever a person is placed in the path of radiation emitted by a device or radioactive substances located outside the body. The radiation emitted can reach this person either directly or after reflection on the walls of the room or the objects they encounter (indirect radiation). Depending on the case, a larger or smaller part of the body can be affected by radiation. A distinction is made between global irradiation, which affect the whole organism, and partial irradiation which affect only one or more organs.

2.2 Radioactive contamination

There is "radioactive contamination" whenever radioactive substances are present in a medium or in contact with a surface where they are undesirable. Human contamination can be either external when radioactive substances are deposited on the surface of the body, or internal when they have entered the body. It generally results from contamination of the environment (atmosphere, work surface, equipment, etc.).

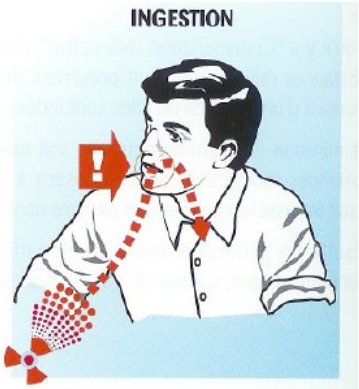
2.2.1 External or skin contamination

Radioactive substances are deposited on the surface of the body, on healthy skin to which they adhere more or less strongly. This essentially results in irradiation of the skin. Exceptionally, some of the radioactive substances may enter the body, giving rise to internal contamination.

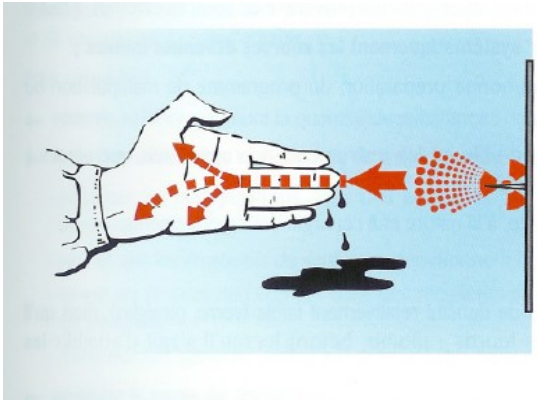
2.2.2 Internal contamination

Radioactive substances can enter the body in three ways: inhalation, ingestion or injury.

Inhalation when radioactives substances are in the air we breathe



Ingestion when radioactives substances are in the drink or food we take or placed on an object that we carry in our mouth



Wound with a contaminated object or through an existing wound

The radioactive substances are then distributed throughout the body. They emit their radiation inside the body, which thus undergoes "internal irradiation". We can note that another way of penetration exists, it is called transcutaneous, and takes place through the pores of the skin (typical example is tritium).

Internal contamination only ceases when the radioactive substances have disappeared from the body after a certain time (the effective period, see paragraph 1.7).

2.2.3 Guide values for internal exposure

To convert the activity of the inhaled or ingested radionuclide into a dose to humans (in Sv), it must be multiplied by a dose factor (or DPUI, effective dose per unit of intake) expressed in sievert per becquerel (Sv / Bq). The dose factors take into account the metabolism of radionuclides in the body once ingested or inhaled, the nature and energy of the radiation emitted, the radiosensitivity of the tissues, etc. They are evaluated using models describing the path of radionuclides in the different compartments of the body. A table of dose factor values is regularly updated by the International Commission on Radiological Protection (ICRP).
In general, the assigned values are several orders of magnitude higher for heavy elements (actinides) than for elements of medium mass (fission products).
The DPUI makes it possible to switch from the activity incorporated in Bq to the effective dose committed in Sv.
We have **E = DPUI * A** with: **E**, the effective dose committed in Sv
DPUI, in Sv / Bq and
A, the activity incorporated in Bq

A specific example for operations at IJCLab Orsay is presented in **appendix H**.

3. Precautions:

3.1 Where could we find the ionizing radiation at IJCLab?

- Handling of intense sealed or unsealed sources, working with X-ray generators and particle accelerators pose a risk of external irradiation;
- Handling unsealed sources carries a double risk of external contamination and internal contamination / exposure;

3.2 Precautions to be taken against external irradiation

- Time: Limit the duration of exposure as much as possible;
- Distance: Work at a sufficient distance from the source (use of pliers);
- Shield: Use shielding adapted to the nature of the radiation and its energy;
- Storage-tagging: Store sources in appropriate and tagged places/containers.

3.2.1 Time

We introduce: $\dot{D} = \frac{D}{t}$

Ḋ: dose rate of absorbed dose, Gy/h

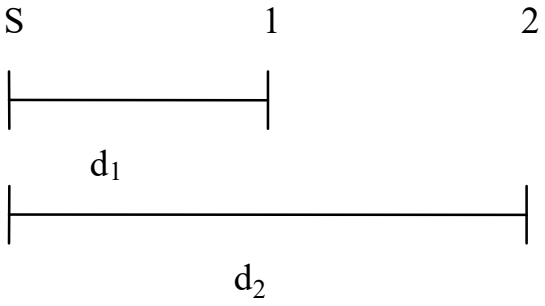
D: absorbed dose, Gy

t: time of exposure, hours

It can be seen that the absorbed dose will be the smaller the shorter the duration of exposure.

3.2.2 Distance

Radiation from photons and neutrons decreases in intensity with the inverse of the square of the distance. Let's assume a point source **S** at a distance **d1** from a point **1** and at a distance **d2** from a point **2**.



Ḋ1: dose rate at point 1

Ḋ2: dose rate at point 2

We have the equation: $\dot{D}_1 * d_1^2 = \dot{D}_2 * d_2^2$

3.2.3 Shielding

The suitable material thickness can decrease the dose rate significantly. The attenuation phenomenon follows an exponential decrease law as a function of the thickness crossed. One therefore introduces a half thickness, noted as **X1/2**, thickness necessary for the reduction by half of the dose rate.

In practice we use: $\dot{D} = \frac{\dot{D}_0}{2^{(\frac{x}{x_{1/2}})}}$

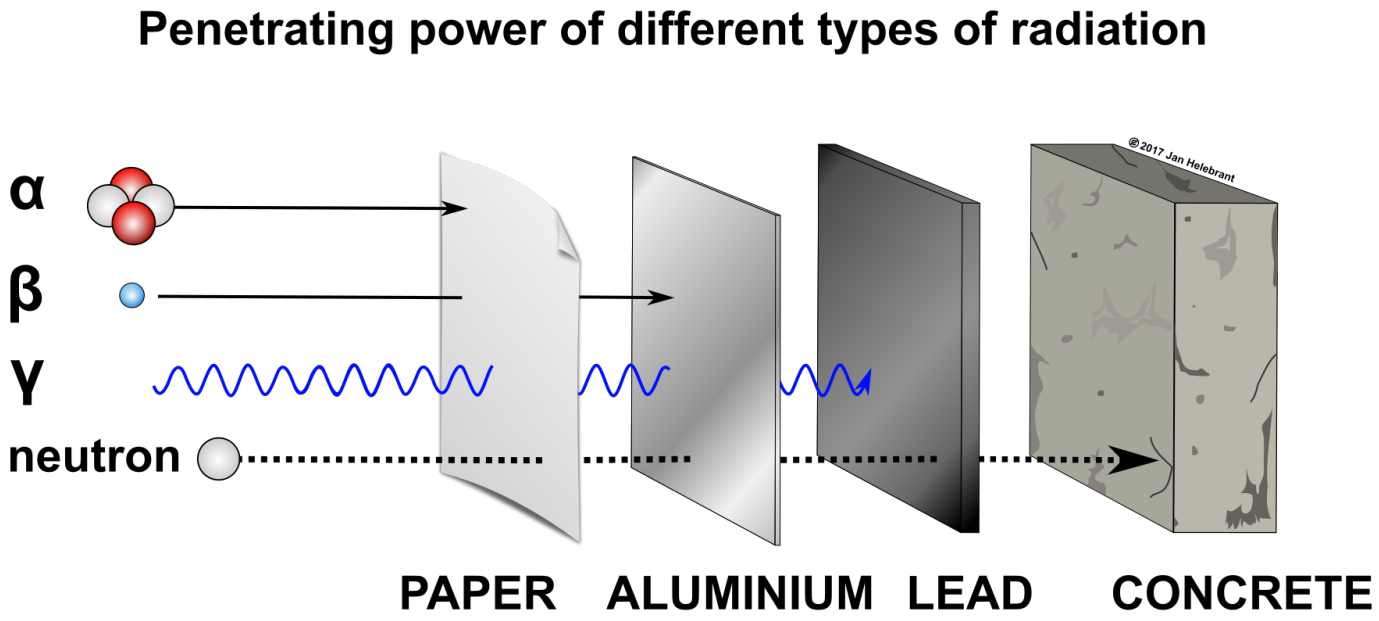
Ḋ: dose rate after shield

$\dot{D}_0$: dose rate without shield

x: shielding thickness

$x_{1/2}$: half value layer

Depending on the nature of the radiation and its penetrating power, the nature of the shield to be interposed may vary:



- Alphas penetrate a few centimeters in the air, they are stopped by a sheet of paper (the major risk is therefore internal exposure);

- Betas (minus) travel up to a few meters in the air for the most energetic; we use shields of glass, plexiglass, aluminum foil, etc. Elements with a low atomic number (Z) are used to limit the bremsstrahlung;

- Photons travel a few hundred meters in the air, shields of concrete, lead (for γ rays), lead glass (for X rays) are used;

- Neutrons travel a few kilometers in the air, shields containing hydrogen, paraffin, polyethylene, concrete or boron are used.
  - Why boron? It has a high neutron absorption cross section (high probability of absorbing neutrons);

  - Why hydrogen? This is a problem of classical mechanics (conservation of angular momentum, movement of the center of mass, elastic collision). The loss of energy of the neutron in the collision with a nucleus is as greater as the mass of this nucleus is smaller.

3.2.4 Storage & Labeling (Tagging)

The sources must be stored in appropriate enclosures (safe or lockbox, equipped with appropriate shielding) that can be locked and marked with radioactive sign indicating the presence of radioactive material. Stickers are available on demand from the SPR.

3.2.5 Radiation type vs risk

Ionizing Radiation	Nature	Ionizing power	Path in air	Path in water	Exposure risk
Alpha	**Helium nuclei**	**+ + +**	**Few cm**	**Few µm**	**Internal**
Beta	**Electron**	**+**	**Few meters**	**Few mm**	**External, skin**
X-rays	**Photon**	**+**	**Hundreds of meters**	**Few cm**	**External, skin**
Gamma	**Photon**	**+**	**Hundreds of meters**	**Tens of cm**	**External**
Neutron	**Neutron**	**+ +**	**Few kilometers**	**Few meters**	**External**

3.3 Handling unsealed sources safely (external and internal contamination):

In this case, it is above all a matter of preventing radioactive substances from dispersing into the work environment and coming into contact with the body. For that it is necessary to:

- Minimize the quantity of radioactive substances to be handled;
- Isolate radioactive substances from the working environment and for this purpose:
  - Carry out operations in suitable enclosures such as glove boxes or fume hoods;
  - Check that the ventilation is functioning correctly;
  - Store unsealed sources in well-closed containers or enclosures as soon as handling is finished;
  - In general, ensure the cleanliness of workplaces.

Protect your body:

- Wear work clothes adapted to the risk of contamination: wearing a lab coat is compulsory;
- Wear disposable gloves (to be changed frequently) for any manipulation on unsealed source;

Be careful, contaminated gloves in their turn contaminate everything they touch.

- Carry out the undressing phases at the end of the operation methodically and without haste (gloves, overboots, lab coat, etc.);
- Drinking, eating, smoking or applying makeup are strictly prohibited.

4. Classification of workers and definition of zones

4.1 Exposure limits for 12 consecutive months

	WORKERS (labor code)		**PUBLIC (public health code)**
	Category **A**	Category **B**	
Whole body (effective dose)	**20 mSv**	**6 mSv**	**1 mSv**
Crystalline (equivalent dose)	**20 mSv**	**15 mSv**	**15 mSv**
Skin (equivalent dose)	**500 mSv**	**150 mSv**	**50 mSv**
Hands, forearms, feet, ankles (equivalent dose)	**500 mSv**	**150 mSv**	**50 mSv**

4.2 Classification of workers

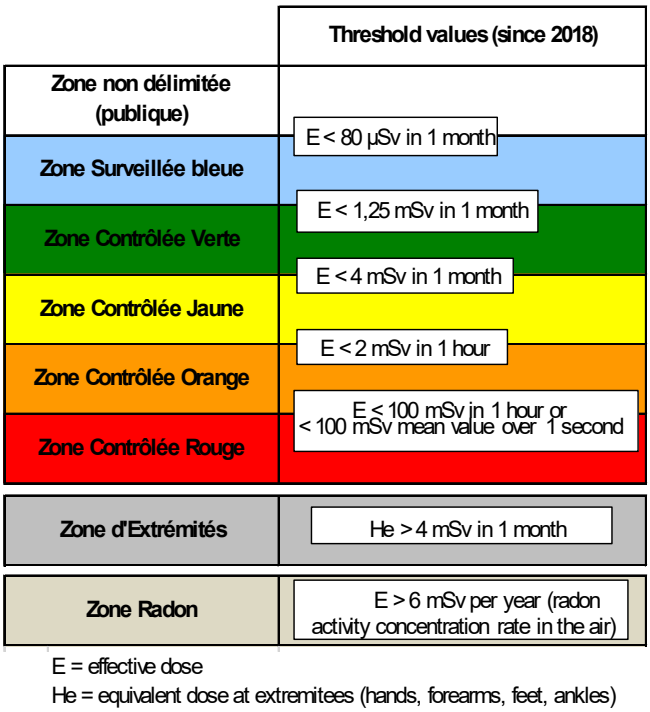
- Category A: Workers whose effective dose may be between 6 and 20 mSv over 12 consecutive months ;
- Category B: Workers whose effective dose may be between 1 and 6 mSv over 12 consecutive months ;
- Public: People whose effective dose must remain below 1 mSv for 12 consecutive months.

Exceptions:

- Apprentices over 15 and under 18: Cannot be classified above category B;
- Pregnant women from the declaration of pregnancy: Public (right of the unborn fetus);
- Nursing women: zero risk of internal exposure (milk is a very effective vector of contamination).

4.3 Definitions and characteristics of restricted areas

They are defined in terms of effective dose limits *(values subject to change).*



E = effective dose
He = equivalent dose at extremitees (hands, forearms, feet, ankles)

- A zone, called the "extremity zone" is now used to materialize this risk. This zone is only put in place when the zone delimited under the effective dose does not guarantee compliance with the occupational exposure limit values for the extremities and the skin.
- No zones are defined for eye lens exposure. However, appropriate signs are put in place when the determination carried out for the effective dose does not guarantee compliance with the occupational exposure limit values for the lens of the eye. It allows the worker to identify the danger and to be informed of any necessary personal protective equipment.
- A new requirement is introduced concerning the risk of exposure to radon. A "radon zone" is delimited when the activity concentration of radon in the air leads to an assessment of an effective dose which exceeds 6 mSv per year.

5. Working instructions

They must appear inside any restricted area on the note "radiation protection instructions". (See appendix A: general radiation protection instructions).

- Personal protective equipment: lab coat, and if necessary gloves, overboots, etc.;
- Collective protective equipment: fume hoods, glove box, shielding, etc.

5.1 Dosimeters

- In Supervised Area: Passive dosimetry is compulsory;
- In the Controlled Area: Passive and operational dosimetry are compulsory.

Operational dosimeter: It allows measuring the equivalent dose or dose rate in real time.

Image right: MGP 3000 type electronic dosimeters currently used at IJCLab. There are different types depending on the radiation to be detected (for gammas and neutrons on the left, for gamma, X and beta rays, on the right).

- Passive dosimeter: It measures the cumulative equivalent dose over a given period; it is the "official" dosimeter. Passive dosimeters make it possible to assess exposure to betas, photons and neutrons:
- Aluminium oxide doped with carbon, using the Optically Stimulated Luminescence (OSL) technology for the gammas, X-rays and betas (pic.1) ;
- Solid nuclear trace detector (DSTN) for the neutrons (pic.1).
- Thermoluminescent Dosimetry (TLD) Ring measures exposure due to x, beta, and gamma radiation with thermoluminescent technology. (pic.2).

1 →

2 →

5.2 Controls

5.2.1 Non-contamination control

In the beginning, during and at the end of a manipulation, or in case of doubt**, the worker must himself carry out a surface non-contamination check using a probe.**This means control of the hands and the working surface.
In our laboratories, we use scintillation probes, adapted to each type of radiation to be detected, associated with a portable polyradiameter (MIP type, see the first two photos below from left to right) or contaminameters that can simultaneously detect alpha, beta, gamma radiation (see third photo, right), and hand / foot detectors.



Before leaving a restricted area where there is a risk of contamination, the worker must check his feet and hands by positioning himself on the devices presented below.


5.2.2 Ambience control, external exposure

When handling or in case of doubt, the user must carry out this type of checks himself and trace it on the block note provided for this purpose.
The devices listed below are used for measurements of dose rates/doses due to photons. If there is a risk of the presence of neutrons, a detector measuring the depth dose can be used in addition. In the big installations (accelerator halls), fixed monitoring systems are operating on a permanent basis.

Babyline for measuring the absorbed dose of γ photons with hood (eye lens equivalent dose) and X, γ and β- without the hood (skin equivalent dose).

Survey meter for measuring the ambient gamma dose rate (depth dose).

Follow the instructions attached in your working area (*cf. precautions to be taken, chapter **3***).

6. Instructions in the case of an incident and/or accident

They must appear inside the restricted areas on the note "radiation protection instructions" **(see appendix A).**

6.1 Contamination risk

Example: dispersion of radioactive substances when handling unsealed sources.

Warning signs:

- Positive contamination control;
- Handling error → search for contamination.

If you witness:

- Working hours: Call SPR, if necessary ;
- Outside working hours: **No handling of non-sealed sources outside working hours!** If needed, call the security post *(contact details on the back of this document below).*

If you are exposed:

- Check (or ask a person competent to do so) to confirm the contamination;
- If confirmed: call the SPR/ Security post ;
- Wait for the intervention, taking care not to disperse the contamination.

6.2 Irradiation risk

Example: unusual situation when using sealed sources, electrical X-ray generators or particle accelerators.

Warning signs:

- Alarm of an operational dosimeter, or of a radiation protection system;
- Ambiance control.

If you witness:

- If the machine has not been already switched off by the safety system, activate the nearest emergency stop (X-ray generator, particle accelerator);
- Evacuate the area near the sealed source.

If you are exposed:

- Leave the restricted area ;
- Go away from the source ;
- If the machine has not been already switched off by the safety system, activate the nearest emergency stop (X-ray generator, particle accelerator);

Witness or exposed:

- Working hours: Call SPR, if necessary ;
- Outside working hours: **No handling of radioactive sources outside working hours!** If needed, call the security post *(contact details on the back of this document below)*.

7. How it works at IJCLab?

This paragraph briefly describes the procedures to be followed and the steps to be taken concerning certain operations related to radiation protection at IJCLab.
All the procedures or instructions mentioned in the following can be viewed on the internal network of the IJClab, inside the "SPR management system" directory.
The Prevention and Radiation Protection Service has a dual role:

- Ensure the management of radioactive substances and waste (by the person in charge for radioactive substances), organization of the transport of hazardous materials (supervised by the transport safety advisor, person external to IJCLab);
- Carry out all the regulatory checks and controls inherent in the handling of radioactive substances (by persons competent in radiation protection).

7.1 Request for experiment with radioactive substances

Refer to the procedure for managing experiments using dangerous substances (radioactive or chemical). We will see in details what is the procedure to follow in this particular case.

7.2 Radiation source purchase

Refer to the ***procedure for purchasing a radioactive source (sealed or unsealed).***
The user addresses his requirements to SPR, which is responsible for managing the supplying procedure.

7.3 Source loan

Refer to the ***radioactive substance traceability procedure***.

7.3.1 Loan of a sealed source

The user must send his request to the manager of radioactive substances via the source loan form (PS, see appendix C). The SPR gives its agreement and is responsible for the radiological control of this source before it is used.

7.3.2 Loan of an unsealed source

The loan of radioactive material in unsealed form is carried out as part of an experiment for which the request has been validated (see paragraph 7.1).
The traceability of changes in the quantities of materials given to user is ensured by *tracking form for unsealed radioactive substances* (BS, see ***appendix D***). **It is essential that the users keep an up-to-date inventory of their experiences (in stock, in use, in waste).**

7.4 Internal source movement

Refer to the ***radioactive source internal movement procedure***.
For movements outside host area of use of sources (sealed or not) for more than 24 hours, the loan holder and the SPR must be consulted. The registration must be completed with *source movement form* (MS, see ***appendix E***). For movements of less than 24 hours, the user must consult and notify the SPR in writing (email).

7.5 Potentially radioactive waste

Internal definition: is considered as potentially radioactive waste, any material or product without any possibility of use or further transformation by its holder, coming from a restricted area or likely to have been contaminated or activated.

7.5.1 Sorting

Sorting is carried out according to the ***sorting instruction for potentially radioactive waste***.
First of all, in order to limit the amount of radioactive waste, it is a question of separating potentially active or not wastes (see sorting instructions in ***appendix B***).

- **Assumed <u>non active</u>:**

Solid:

- Paper, cardboard, plastic, clean glass;
- Metals and wood ;
- Technological waste;
- Chemicals (including empty bottles), asbestos, lead and neon tubes.

Liquids:

- Aqueous solutions;
- Halogenated organic solvents;
- Non-halogenated organic solvents;
- Oils.

- **Assumed <u>active</u>:**

Solid:

- Incinerables (paper, rags, gloves, plastics, coats, overboots, dry wood, etc.);
- Non-incinerable, compactable (plastics, compactable metals, bakelite caps, etc.);
- Non-incinerable & non compactable (massive metal parts, glass.) ;
- Scintillation vials (separate plastic and glass) closed and full.

Liquids:

- Aqueous solutions;
- Organic solvents;
- Oils.

Warning: apart from liquid scintillation waste and certain non-incinerable solid powder products, the vials must be empty and unscrewed. It is also necessary to respect the limitations in toxic elements, chemicals, halogenated products, sulfur, nitrates, phosphates, heavy metals (see ***appendix B***).

7.5.2 Waste management

Refer to the ***potentially radioactive waste management procedure***.

Any waste from a regulated zone by the meaning of radiation protection must be a subject of a special request to the SPR, even if it is assumed to be inactive. An *elimination form for potentially radioactive waste* (BE, see ***appendix F***) duly completed must accompany the package.
The package must be clearly identified. The SPR must be notified as soon as possible to carry out the removal.

7.6 Parcels with radioactive substances

The SPR must be informed and consulted before any transport operation (contact details appear on the last page of this document), whether for receiving or shipment.
The SPR checks external exposure and non-contamination on arrival or departure of parcels. Refer to the ***shipping procedure for radioactive substances***, to the ***procedure for receiving radioactive substances*** and the ***radioactive material transport guide***.

7.7 Exit from a restricted area except for waste disposal

For objects or equipment intended to leave a restricted area, the SPR must be notified in advance in order to carry out a check for non-contamination and / or risk of external irradiation (activation). Depending on the result of the control, the report issued by the SPR agent will be favorable or not (or under certain conditions) for these objects or materials.
This is described in the ***instruction for radiological checks on request***.

7.8 Escort procedure

If an external person enters the restricted area, he or she is escorted by an agent of IJCLab, who is himself authorized to enter this particular area.
This involves contacting the SPR in advance, at least 24 hours, so that it can prepare an operational dosimeter that will accompany the visitor throughout his intervention in the restricted area.
In buildings 107H (radio chemistry), 109N (ALTO) and 209C (ThomX), where "visitor" dosimeters are provided, the register at the entrance must be completed.
This is described in the ***procedure for using operational dosimeters and registering the results.***

8. Regulatory developments

Reference texts in the field of radiation protection are available on the website of the Nuclear Safety Authority (www.asn.fr).Recent developments include (non-exhaustive list):

- Décret n° 2018-434 du 4 juin 2018 containing various provisions on nuclear substances;
- Décret n° 2018-437 du 4 juin 2018 on the protection of workers against risks due to ionizing radiation;
- Décret n° 2018-438 du 4 juin 2018 on protection against the risks due to ionizing radiation to which certain workers are subjected.
- Arrêté du 28 janvier 2020 modifiant l'arrêté du 15 mai 2006 amended relating to the conditions for delimiting and signaling supervised and controlled areas and specially regulated or prohibited areas in view of exposure to ionizing radiation, as well as the rules of hygiene, safety and maintenance which are imposed therein ;
- Arrêté du 23 octobre 2020 relating to the measurements carried out within the framework of the risk assessment and the verifications of the effectiveness of the preventive means put in place within the framework of the protection of workers against the risks due to ionizing radiation;
- Arrêté du 4 mars 2021 portant homologation de la décision n°2021-DC-0703 de l'Autorité de sûreté nucléaire du 4 février 2021 establishing the list of nuclear activities using sources of ionizing radiation for industrial, veterinary or research purposes (excluding research involving humans).

9. Conclusion

The essentials to remember:

- Know the risks, the main emissions and associated risks;
  The risk is reduced:
  - By limiting the exposure **time** ;
  - By increasing the **distance** to the radiation source ;
  - By interposing a **shield** of suitable material;
  - By carrying out relevant **storage** and **tagging**.
- Take precautions :
  - Wearing a lab coat and a dosimeter (s), gloves, etc.;
  - Do not stay in contact with a source.
- Apply the instructions:
  - Under normal conditions;
  - In case of an incident / accident.

Practical on-the-job training is the responsibility of the supervisor or permanent staff supported by SPR. At the end of this training, a form attesting it is duly completed and signed by the person concerned, the supervisor and the SPR. It comprises specific information, training on good radiation protection practices (checks on work equipment, checks by the agent himself) and those specific for the use of particular equipment (for example working under fume cupboard, operations in glove boxes, verification of correct functioning, etc.).

10. References for this document

- List of applicable documents of SPR at IJCLab Orsay ;
- Information notice concerning work under ionizing radiation, COGEMA La Hague, October 2000 edition;
- Internet Sites :
  - The Nuclear Safety Authority: www.asn.gouv.fr
  - The public service of the law diffusion: www.legifrance.gouv.fr
  - The French society of medical physics: www.sfpm.asso.fr
  - The Atomic Energy and Alternative Energies Commission : www.cea.fr
  - The National Research and Security Institute: www.inrs.fr

11. Appendices

A. Radiation protection instructions

IJCLab Irène Joliot-Curie
Laboratoire de Physique des 2 Infinis

CONSIGNES GÉNÉRALES DE RADIOPROTECTION (application du code du travail)

I. DISPOSITIONS GÉNÉRALES

Toute personne ayant accès à l'établissement est tenue de respecter les consignes générales et les consignes particulières propres aux installations.

L'accès aux zones délimitées est restreint aux travailleurs classés. Toutefois, l'accès occasionnel des travailleurs non classés aux zones surveillée bleue et contrôlée verte est possible sous réserve de l'accord de l'employeur et du respect de la valeur limite d'exposition du public soit 1 mSv sur 12 mois glissants.

Ne peuvent être introduites dans l'établissement que les sources déclarées à l'Autorité de Sûreté Nucléaire (ASN), et pour lesquelles une autorisation de détention et d'utilisation existe.

Tout travailleur affecté à une zone délimitée, même s'il est appelé à n'y pénétrer qu'occasionnellement doit :

- Prendre connaissance des notices d'informations relatives à la radioprotection et à la sécurité.
- Porter en permanence le dosimètre individuel à lecture différée (passif) pendant toute la durée du séjour en zone surveillée bleue et les dosimètres passif et opérationnel pendant toute la durée du séjour à partir de la zone contrôlée verte. Pour les visiteurs, un dosimètre opérationnel ou à lecture immédiate peut leur être attribué afin d'attester du niveau de leur potentielle exposition.
- Porter la tenue de travail, les dispositifs et équipements de protection individuelle exigés dans les consignes particulières propres à chaque installation (voir affichages dédiés).
- Effectuer les contrôles d'exposition externe et / ou de non contamination selon le(s) risque(s) inhérent(s) à chaque zone de travail.
- Se soumettre aux examens médicaux périodiques.

Toute femme enceinte, dès qu'elle prend connaissance de sa grossesse, est tenue d'en informer le service médical. Tout travail susceptible de présenter un risque accru d'exposition aux rayonnements pour les travailleurs doit faire l'objet d'une communication au service de prévention des risques (SPR) avant le début des opérations. Celui-ci procédera à une évaluation individuelle de l'exposition.

Matériel et déchets :
Tout matériel sortant de zone délimitée où existe un risque de contamination ou d'activation doit faire l'objet d'un contrôle préalable de non contamination radioactive ou d'activation.
Tout déchet sortant de zone délimitée doit faire l'objet d'une demande de prise en charge par les services compétents (bon d'enlèvement) et d'un contrôle par le SPR.

De façon générale, il est interdit d'introduire dans ce local :
De la nourriture, des boissons, des articles pour boire, manger, fumer ou se maquiller.
Des mouchoirs de poche autres que les mouchoirs en papier que l'on dépose après usage dans une poubelle à déchets potentiellement radioactifs.

II. DISPOSITIONS PARTICULIÈRES POUR LE RISQUE D'EXPOSITION EXTERNE

Optimiser le temps d'exposition et travailler éventuellement derrière des écrans ayant pour but d'atténuer les rayonnements ionisants et manipuler à l'aide de pinces.

Après utilisation, ranger immédiatement la source radioactive dans son récipient, l'entreposer dans un endroit éloigné du poste de travail (l'intensité du rayonnement décroît avec la distance).

Effectuer un contrôle de non contamination des personnes, au poste de travail, avant de quitter les lieux et se laver les mains après chaque fin de manipulation.

Consignes_générales_RP_V3 du 19/11/2020

IJCLab
Irène Joliot-Curie
Laboratoire de Physique des 2 Infinis

CONSIGNES GÉNÉRALES DE RADIOPROTECTION (application du code du travail)

III. DISPOSITIONS PARTICULIÈRES POUR LE RISQUE DE CONTAMINATION RADIOACTIVE

Interdiction formelle :
De manipuler les sources radioactives à mains nues.
De pipeter une solution radioactive à la bouche.
D'introduire des affaires personnelles sans utilité pour le travail à réaliser.

Avant de quitter le local :
•Stocker les sources dans des récipients appropriés et entreposées dans une enceinte spéciale isolée, fermant à clé.
•Procéder à un contrôle de contamination éventuelle des plans de travail, sols sous ces derniers, des mains, des vêtements de travail et des chaussures.

IV. BALISAGE ET SIGNALISATION

Les indications fournies par le balisage et la signalisation doivent être rigoureusement respectées.
Les sources radioactives doivent être repérées par une signalisation évidente.

V. TRANSPORTS ET TRANSFERTS DE MATIÈRES RADIOACTIVES

Les transports empruntant la voie publique doivent satisfaire aux prescriptions réglementaires relatives au transport des matières dangereuses. Ils doivent dans tous les cas faire l'objet d'un accord préalable du SPR. Toute substance radioactive arrivant au laboratoire, quelle qu'en soit la nature ou l'activité, doit être réceptionnée par un agent du SPR compétent en radioprotection prévenu a minima 48 heures avant la date de l'opération. De même, pour les transferts de substances radioactives entre deux salles d'un même bâtiment ou deux bâtiments d'IJCLab, et pour des raisons de traçabilité et de sécurité, le SPR doit être informé et avoir donné son accord à la réalisation de l'opération.

VI. INCIDENT, ACCIDENT

En particulier, incident avec les sources, contamination :
Appeler le SPR : 01 69 15 71 33

Le conseiller en radioprotection (CRP) se chargera de contacter l'ASN.
IRSN (Institut de Radioprotection et de Sûreté Nucléaire), BP 17 – 92262 Fontenay-aux-Roses
Tél. : **06 07 31 56 63**
ASN, 15, rue Louis Lejeune CS 70013 92541 Montrouge cedex.
Numéro vert : **0800 804 135**
Tél. : **01 46 16 40 00**

CONSIGNES D'URGENCE **SPR**
La journée
INCENDIE : 18 Pompiers ou **112** Appel d'urgence
ACCIDENT : 15 SAMU ou **112** Appel d'urgence
Gardien Campus : 19 ou **01 69 15 79 99**
Pour signaler l'appel aux secours et les orienter
Week-end, fermetures IJCLab
Gardien (bât. Ex IPN) : **14** ou **01 69 15 71 11**
CONTACT SPR : spr@ijclab.in2p3.fr

Le directeur d'IJCLab,
A. STOCCHI (01 69 15 51 57)
Le 18 / 11 / 2020

Le CRP d'IJCLab,
S. WURTH (01 69 15 67 26)
Le 18 / 11 / 2020

Consignes_générales_RP_V3 du 19/11/2020

	CNRS – IN2P3 – UNIVERSITÉ PARIS - SACLAY Laboratoire de Physique des 2 Infinis – Irène Joliot-Curie – 91406 ORSAY Cedex
Consignes_tri_dechets_actifs_V3 Version du 28/05/2021	SERVICE PRÉVENTION DES RISQUES

Consignes de tri des déchets potentiellement actifs

Solides Incinérables

Utilisez exclusivement des sacs transparents en polyéthylène haute densité mis à disposition par le SPR

Autorisés :

✓ **Papier, Gants nitriles ou latex, Chiffonnettes, Bois sec Matériel plastique non halogéné, Tubes et flacons en polyéthylène débouchés, Absorbant organique, Cellulose (blouse ou pantalon du labo), Carton, benchkote**

Attention: présence des éléments toxiques/chimiques: Cl, S, PO_4, NO_3, Br, F, Ni, Cd, Se, Tl, Hg, Co, Cr, Cu, Mn, Sb, Pb, Sn, V, As, Zn à renseigner obligatoirement sur le bon d'enlèvement

Interdits :

✘ **Verre,Métal,Câbles,Tubes et flacons bouchés,Liquides ou déchets imbibés, Putrescibles, Infectieux, CMR, Explosibles, Néon, Bombes aérosols, Piles, Papier aluminium**

Solides Compactables

Autorisés :

✓ **Papier, Gants nitriles ou latex, Filtres secs, Matériel plastique, Papier aluminium – à renseigner la quantité, Pièces métalliques < 5 mm, Câbles électriques, Caoutchouc, Polystyrène**

Attention : présence des éléments chlorure, fluorure, nitrate, sulfate, carbonate, EDTA, NTA, DTPA, TTHA, oxalate, citrate, acétate, formiate, ascorbate, gluconate, sulfamate, phtalate, acide picolinique, TBP, éthy-lène-diamine et sulfonate : à renseigner obligatoirement sur le bon d'enlèvement

Interdits :

✘ **Verre, Bois, Déchets contenant des gaz, Tubes et flacons bouchés, Liquides ou déchets imbibés, Putrescibles, Infectieux, CMR, explosibles, Néon, Bombes aérosols, Piles, Déchets dangereux (aiguilles, lames), Tuyauterie, Cartouche de masque**

Solides Non Compactables

Utilisez exclusivement des sacs transparents en polyéthylène haute densité mis à disposition par le SPR

Autorisés :

✓ **Métal, Papier aluminium – à renseigner la quantité, Verrerie, céramique, Terre, gravats, Matériel plastique, Bois, Cartouche de masque, Bombes aérosols (vidées et percées), Pulvérulents (sac d'aspirateur)**

Attention: présence des éléments toxiques/chimiques : Cl, S, PO_4, NO_3, Br, F, Ni, Cd, Se, Tl, Hg, Co, Cr, Cu, Mn, Sb, Pb, Sn, V, As, Zn, chlorure, fluorure, nitrate, sulfate, carbonate, EDTA, NTA, DTPA, TTHA, oxalate, citrate, acétate, formiate, ascorbate, gluconate, sulfamate, phtalate, acide picolinique, TBP, éthy-lène-diamine et sulfonate à renseigner obligatoirement sur le bon d'enlèvement

Interdits :

✘ **Objets piquants, coupants, tranchants non protégés, Objets amiantés, Déchets contenant des gaz, Tubes et flacons bouchés, Liquides ou déchets imbibés, Putrescibles, Infectieux, CMR, explosibles, Néon, Bitume, Piles, Déchets électroniques**

Scintillation Liquide (flacon de scintillation verre ou polyéthylène)

Autorisés :

✓ **Petits tubes ou flacons en polyéthylène ou verre d'un volume de 20 ml, plaques multi-puits et microtubes bouchés, vides ou non-vidés. Le liquide contenu doit être du liquide de scintillation, composé de solvants organiques et leur mélange dédié à la mesure. Epaisseur de verre maximale de 1 mm. Standard de calibration.**

Interdits :

✘ **Tout autre déchet (gants, papier, absorbant). Explosif, toxique, biologique, putrescible, CMR, amianté. Les flacons de sources mères.**

UMR 9012 du CNRS/IN2P3, de l'Université Paris-Saclay et de l'Université de Paris

Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie
SERVICE PRÉVENTION DES RISQUES

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

PS_V4	**SUBSTANCES RADIOACTIVES**	Version du 01/02/2021

Cadre réservé au SPR

PRÊT DE SUBSTANCE RADIOACTIVE SOUS FORME SCELLEE	**PS** _ _ _ _ /_ _ /_ _ (PS /aaaa/mm/n° d'ordre)

- Est considérée comme **scellée** toute substance radioactive **non dispersable dans les conditions normales d'utilisation.**
- Ce document est établi par le **demandeur** et transmis au **SPR** pour traitement.

PARTIE RESERVEE A L'UTILISATEUR

INFORMATIONS CONCERNANT L'UTILISATEUR

Nom : **Prénom :** **Téléphone :**

Service/Groupe : **Email :**

INFORMATIONS CONCERNANT LA SUBSTANCE RADIOACTIVE DEMANDEE

Référence de l'expérience *(le cas échéant)* **:**

Radionucléide(s) : **Activité nominale demandée :**

Forme physico-chimique :

Nature du support *(le cas échéant)* **:**

INFORMATIONS CONCERNANT LES LOCAUX ET L'UTILSATION

Lieu d'utilisation :

Bâtiment : **Pièce(s) :** **Utilisation prévue :**

Zone : Non réglementée ☐ Surveillée bleue ☐ Contrôlée verte ☐

Lieu d'entreposage (durant le prêt) :

Bâtiment : **Pièce(s) :** **Utilisation prévue :**

Zone : Non réglementée ☐ Surveillée bleue ☐ Contrôlée verte ☐

Durée souhaitée pour le prêt :

Remarques/Observations :

PARTIE RESERVEE AU SPR

INFORMATIONS CONCERNANT LA SUBSTANCE RADIOACTIVE PRETEE

Référence de la substance radioactive :

Radionucléide(s) : ☐ un seul radionucléide : ☐ plusieurs radionucléides :

Activité (Bq) : **à la date du :**

La substance radioactive mise à disposition est conforme à la demande de l'utilisateur :

☐ oui ☐ non

Si non, détails des modifications par rapport à la demande :

Date de restitution prévue :

Référence du contrôle avant la mise en service de la substance par la SPR :

Date :		**VISA SPR**		**Observations/Remarques :**
Nom :				

UMR 9012 du CNRS/IN2P3, de l'Université Paris-Saclay et de l'Université de Paris

Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie
SERVICE PRÉVENTION DES RISQUES

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

PS_V4 | SUBSTANCES RADIOACTIVES | Version du 01/02/2021

Cadre réservé au SPR

PRÊT DE SUBSTANCE RADIOACTIVE SOUS FORME SCELLEE | PS _ _ _ _ /_ _ /_ _ (PS /aaaa/mm/n° d'ordre)

- Est considérée comme **scellée** toute substance radioactive **non dispersable dans les conditions normales d'utilisation.**
- Ce document est établi par le **demandeur** et transmis au **SPR** pour traitement.

PRECAUTIONS D'USAGE ET RESPONSABILITES

Je soussigné NOM Prénom , reconnais avoir pris la responsabilité de la substance radioactive caractérisée ci-avant et avoir été informé des précautions à prendre pour sa manipulation et son entreposage.

Je m'engage notamment à :

- l'utiliser en respectant les règles de radioprotection et en veillant à ce que les utilisateurs soient le moins exposés possible,
- ne pas céder la source à quelque titre que ce soit,
- émettre un *formulaire de mouvement de source*, pour tout mouvement interne hors des locaux d'utilisation initialement prévus (> 24h),
- signaler sans délai au SPR toute perte, vol ou détérioration de cet élément,
- présenter la source au contrôle semestriel,
- restituer la source en fin d'utilisation ou au départ définitif du laboratoire.

MISE A DISPOSITION DE LA SOURCE

Le prêt est effectif à partir de la date de signature de la section prévention du SPR.

Visa	Utilisateur	SPR
Date		
Nom		
Signature		

REPRISE DE LA SUBSTANCE RADIOACTIVE

Source restituée le :

Destination : ☐ Retour fournisseur ☐ Prêt pour un autre utilisateur ☐ Prêt à un laboratoire extérieur ☐ Mise en déchets ☐ Entreposage salle des coffres ☐ Autre :

Observations/Remarques :

Visa	Utilisateur	SPR
Date		
Nom		
Signature		

D. Unsealed radioactive substances tracking form (template)

UMR 9012 du CNRS IN2P3 et de l'Université Paris-Saclay

Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie

SERVICE PRÉVENTION DES RISQUES

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

BS_V4	SUBSTANCES RADIOACTIVES	Version du 30/03/2021

BORDEREAU DE SUIVI DES SUBSTANCES RADIOACTIVES NON SCELLÉES N°	BS/aaaa/mm/xx

ANNEE/MOIS/N°D'ORDRE (réservé au SPR)

RAPPEL : Ce document est établi par le gestionnaire des substances radioactives et transmis au responsable du pool concerné par l'opération pour validation et enregistrement. L'original signé est conservé par le gestionnaire des substances radioactives. Ce formulaire est également valable pour le suivi des matières nucléaires non radioactives (deutérium, lithium 6).

SUBSTANCE (radionucléide ou matière nucléaire) :			
AJOUT DE MATIÈRE			
MISE À DISPOSITION DEPUIS LE STOCK D'IJCLAB			
Référence de la matière mise à disposition :		Référence contrôle SPR :	
Type de prélèvement	☐ total ☐ partiel Activité/Masse nette restante :		
Référence du pool où la matière est ajoutée :		Activité/Masse ajoutée :	
TRANSFERT DE MATIÈRE DEPUIS UN AUTRE POOL			
Référence du pool où la matière est prélevée :			
Référence du pool où la matière est ajoutée :		Activité/Masse ajoutée :	
RÉINTÉGRATION DE MATIÈRE EXPEDIÉE HORS D'IJCLAB			
Référence du pool où la matière est ajoutée :			
En provenance de :		Activité/Masse réintégrée :	
DIMINUTION DE LA QUANTITÉ DE MATIÈRE			
EXPÉDITION DE MATIÈRE HORS D'IJCLAB			
Référence du pool où la matière est prélevée :			
À destination de :		Activité/Masse expédiée :	
RETOUR DE MATIÈRE EN STOCK			
Référence du pool où la matière est prélevée :			
Activité/Masse remise en stock :			
MISE EN DÉCHETS			
Référence du pool d'où proviennent les déchets :			
Référence des déchets (n° de bon d'enlèvement) :			
Activité/Masse totale :			
ÉCART DE QUANTITÉS - DÉCROISSANCE			
Référence du pool :			
Type d'écart :	☐ Incorporation matière ☐ Décroissance ☐ Perte matière	Valeur de la quantité (activité/masse) :	
ANNULATION ET REMPLACEMENT D'UNE OPÉRATION			
N° BS annulé :		Date opération initiale :	
Donnée à modifier *(le cas échéant)* :	☐ Masse/Activité ☐ Quantité d'articles ☐ Autres (précisez) :	Ancienne valeur : Nouvelle valeur :	
Remarques Observations :			

Visa	Gestionnaire des substances radioactives	Responsable du pool
Nom		
Date		
Signature		

LABORATOIRE DE PHYSIQUE DES 2 INFINIS IRENE JOLIOT-CURIE - SPR - 91405 - ORSAY – CEDEX

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E. Sealed source movement form (template)

UMR 9012 du CNRS/IN2P3, de l'Université Paris-Saclay et de l'Université de Paris	Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie **SERVICE PRÉVENTION DES RISQUES**	IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis
MS_V4	**SUBSTANCES RADIOACTIVES**	Version du 01/02/2021

Cadre réservé au SPR

MOUVEMENT DE SOURCE	**MS** _ _ _ _ / _ _ / _ _ (MS / aaaa / mm / n° d'ordre)

RAPPELS :
- Ce document est établi par le demandeur et transmis au SPR pour traitement.
- Le demandeur devient responsable de la source pendant la durée du mouvement.
- En fin de mouvement, la source doit être remise dans le local d'origine et sous la responsabilité du titulaire du prêt de source.

PARTIE RESERVEE AU DEMANDEUR

INFORMATIONS SUR LE DEMANDEUR

Nom : **Prénom :** **Téléphone :**

Service/Groupe : **Email :**

INFORMATIONS SUR LA SOURCE

N° Source : **Radionucléide(s) :** **Activité (Bq) :**

Source : ☐ Scellée ☐ Non scellée

Titulaire du prêt : *NOM/Prénom :* *Fiche de prêt PS : aaaa / mm / xx*

Lieu actuel d'utilisation : *Bâtiment :* *Pièce :*

Forme physico-chimique :

INFORMATIONS SUR LE NOUVEAU LOCAL ET L'UTILSATION

Bâtiment : **Pièce :**

Zone :
- ☐ Non réglementée
- ☐ Surveillée bleue
- ☐ Contrôlée verte
- ☐ Autres :

Enceinte de stockage : ☐ Oui : ☐ Non

Utilisation prévue :

Date de départ souhaitée : **Durée prévue :**

PARTIE RÉSERVÉE AU SPR

Opération(s) préalable(s) au transfert :

Mouvement réalisable :
- ☐ par le SPR
- ☐ par le demandeur sans prescriptions particulières
- ☐ par le demandeur avec la(es) prescription(s) suivante(s) :

Pour l'aller :

Pour le retour *(si différent de l'aller)* :

Nom :

Date et Visa :

TANSFERT ALLER

Transfert réalisé le : **Par :**

Visa	Titulaire du prêt	Demandeur	SPR
Nom			
Signature			

TRANSFERT RETOUR

Transfert réalisé le : **Par :**

Visa	Titulaire du prêt	Demandeur	SPR
Nom			
Signature			

Remarques/Observations :

LABORATOIRE DE PHYSIQUE DES 2 INFINIS IRENE JOLIOT-CURIE - SPR - 91405 - ORSAY - CEDEX
page 1 sur 1

F. Potentially radioactive waste elimination form (template)

UMR 9012 du CNRS IN2P3 et de l'Université Paris-Saclay

Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie
SERVICE PRÉVENTION DES RISQUES

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

BE_V3	SUBSTANCES RADIOACTIVES	Version du 17/06/2020

BON D'ENLÈVEMENT DE DÉCHETS POTENTIELLEMENT RADIOACTIFS

À remplir pour tout rejet final (non réutilisable) provenant d'une zone réglementée ou estimé potentiellement actif

À REMPLIR PAR LE DEMANDEUR

IDENTIFICATION

Date de fermeture conteneur :	08/06/2021
Bâtiment origine :	100
Pièce origine :	A225
N° d'ordre conteneur :	02

ÉTIQUETAGE : à faire apparaître clairement sur le conteneur de façon fixe

Bâtiment origine	*Pièce origine*		*Année*	*Mois*	*Jour*	*N° d'ordre*
100	**A225**	-	**2021**	**06**	**08**	**02**

IMPORTANT : CHAQUE conteneur de déchets doit faire l'objet d'UN bon d'enlèvement distinct. Le producteur de déchets doit s'assurer que le choix des numéros d'ordre ne conduit pas à créer deux étiquettes portant le même numéro. Une fois les conteneurs fermés et les bons archivés, il est IMPÉRATIF de prendre contact avec la SPR pour déterminer le mode de mise à disposition AVANT de déplacer les conteneurs hors de la zone d'origine. Les BE doivent être établis et SIGNÉS par le demandeur avant de quitter la zone d'origine. Ne pas coller le bon d'enlèvement sur le conteneur avec du ruban adhésif.

Demandeur :	*NOM*	*Prénom*	*Service*	*Poste*	*e-mail :*
	NOM	Prénom	Service	01 69 15 XX YY	nom@ijclab.in2p3.fr

TYPE DE CONTENEUR (couleur sac, fût, etc.) :

NATURE ET ACTIVITÉ SUPPOSÉES DES MATIÈRES

DÉCHETS "MÉNAGERS" (supposé sans activité ajoutée) : [X]

DÉCHETS "ACTIFS" (détails ci-dessous) : [ ]

Radionucléides	N° expérience	Activité estimée (Bq)	Nature	Provenance (marque ou sigle fournisseur)	Remarques
?					

FORME DES DÉCHETS ET RISQUES ASSOCIÉS

1 - Solides incinérables : papier, plastique, chiffons, gants, matériel chimie PE, surbottes, bois, etc.

2 - Solides compactables : câbles electriques, caoutchouc, plastique, etc.

3 - Solides non compactables : verrerie, pièces métalliques massives, activées, contaminées…

4 - Flacons de scintillations pleins et fermés (contenant encore l'échantillon actif)

FORME :	1 - Solides incinérables	[X]	Solution aqueuse	[ ]
	2 - Solides compactables	[ ]	Solvant organique	[ ]
	3 - Solides non compactables	[ ]	Huile	[ ]
	4 - Flacons de scintillation pleins	[ ]	Autre *(précisez dans les remarques)* :	[ ]
RISQUES :	Corrosif :	[ ]	Inflammable :	[ ]
	Explosif :	[ ]	Toxique :	[ ]
	Autre risque :	[ ]	*Précisez :*	

MISE À DISPOSITION POUR CONTRÔLE RADIOPROTECTION

Date : 08/06/2021
Nom : NOM
Signature :

Remarques et commentaires généraux

LABORATOIRE DE PHYSIQUE DES 2 INFINIS IRENE JOLIOT-CURIE - SPR - 91405 - ORSAY – CEDEX
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G. Personal dosimeter request form (example)

UMR 9012 du CNRS IN2P3 et de l'Université Paris-Saclay Université de Paris

Laboratoire de Physique des 2 Infinis - Irène Joliot-Curie

SERVICE PRÉVENTION DES RISQUES

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

DDPE_V1	SUIVI DOSIMÉTRIQUE	Version du 01/12/2020

Personal dosimeter request

Personal data			
SURNAME:		NAME:	
Email address	Phone	Birth date	Social security number (french)

WORKPLACE					
Building		Office		Dosimeter board (optional):	

EMPLOYER					
CNRS	☐	Université Paris - Saclay	☐	Other	

DOSIMETRY

PERSONAL DOSIMETER

Exposed to following radiation type:

Beta	☐	X	☐	Gamma	☐	Neutrons	☐

Dosimeter type :

Chest - whole body Hp(10):	Simple dosimeter (beta & gamma)	☐	Extremity (Ring) Hp(0,07):	☐
	Neutron dosimeter (beta, gamma & neutron)	☐	Eye lens Hp(3):	☐

Periodicity:

Quarterly :	☐	Monthly	☐	Single / Mission	☐
Start date:		End date:			

OPERATIONAL DOSIMETER (required for controled area only acces)

For acces only to a specific controled area	107H	☐	109N	☐	IGLEX	☐

Comments or observations

Documents required in order to obtain a dosimeter:

- medical certificate (< 2 years) that states you are allowed to work under ionizing radiation;
- a valid Radiation Protection training (< 3 years) and "New Incomers" training;
- if you go on a mission with acces to a radiation controled area, you should send the date your mission begins and its duration as well as the radiations to consider;

Applicant :	Head of service or Tutor :	SPR :
Date :	Name, date & visa :	Date & visa :

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H. Example for internal exposure values (order of magnitude)

At IJCLab, the most frequently used unsealed radioisotope is natural uranium. The specific activity of natural uranium is considered to be 25400 Bq / g.

- For comparison, the external exposure (external irradiation) is evaluated as $2,1 * 10^{-6}$ µSv/h/Bq for a point source at 30 cm (whole body), so for 1 g d'Unat : < 0,1 µSv/h.

- For the internal exposure, the values are as follows:
  - Inhalation (for compound like UO_2F_2 with size 5 µm) : $1,6 * 10^{-5}$ Sv/Bq.
  - Ingestion (UO_2, U_3O_8) : $5,2 * 10^{-8}$ Sv/Bq.

There is a factor of 300 between the two types of incorporation.

- Ingestion of one gram of natural uranium, or 25 400 Bq, generates a dose of 1,32 mSv.

The same approach for inhalation results in a dose of approximately 400 mSv, which is 20 times the effective dose limit (internal **AND** external exposure) for an entire year of a Class A worker!

- The calculation for inhalation, to be realistic, must take into account at least:
  - Volatility factor of the element (0,001 for Unat),
  - Room volume (we take 50 m³),
  - Human respiratory flow (1,2 m³/h),
  - Duration of exposition : we assume that the working handles 1 g of uranium on a lab table during 40 hours ;

  Depending on whether we are working on a table, fume hood or glove box, we can also introduce an additional safety factor, that increases with the confinement.

  ⇒ The dose generated by inhalation is therefore 25400 * 0,001 * (1/50) * 1,2 * 40 * $1,6 * 10^{-5}$ = 0,4 mSv.

Notes

Useful contact details:

- Service de Prévention des Risques: spr@ijclab.in2p3.fr & 01 69 15 71 33 (general)

- Medical service CNRS, office at Gif-sur-Yvette : service.medical@dr4.cnrs.fr

- Medical service Université Paris-Saclay : https://adonis.universite-paris-saclay.fr/adonis/annuaire/num_indispensables.php

- Security post : Inside IJCLab dial simply 14 or 01 69 15 71 11
All weekend, holidays, days off IJCLab and between 20 h and 8 h

Names and coordinates up to date are available on the intranet web page : https://intranet.ijclab.in2p3.fr

For all questions:
spr@ijclab.in2p3.fr
01 69 15 71 33

SAFETY IS EVERYONE'S BUSINESS