Local radiation safety rules for work with

RADIOACTIVE SUBSTANCES

at Karolinska University Hospital

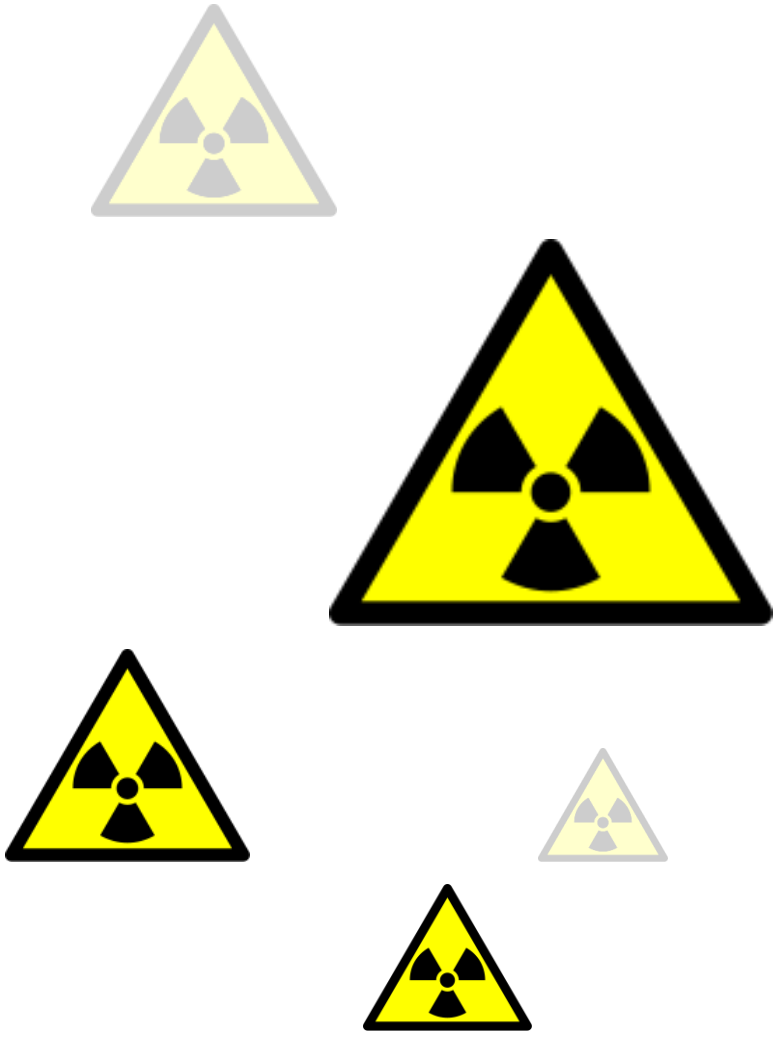

Table of Contents

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Introduction

Work that involves ionizing radiation is associated with risks to the worker, surrounding persons, and the environment. To minimize these risks, work with radioactive substances must take place in accordance with the local regulations described in this document and in accordance with established routines in the workplace.

Work with radioactive substances requires a permit from the Swedish Radiation Safety Authority. Holders of a permit must meet certain requirements based on the laws and regulations that regulate this type of activity. Region Stockholm and The Karolinska Institute both hold such permits from the Swedish Radiation Safety Authority.

Based on the existing permits, Nuclear Medicine grants local licenses to the laboratories that work with open radiation sources within the hospital premises. Without a valid local license, it is not permitted to conduct work with open radiation sources on Karolinska University Hospital's grounds. Licenses are issued provided that the local radiation protection regulations are complied with and that the annual radiation safety round has been carried out without serious remarks.

The local radiation protection regulations are divided into three chapters for greater clarity. The first chapter covers conditions that must be met before starting work with open radiation sources. The second chapter describes guidelines that are central to safe laboratory work with ionizing radiation. The third chapter contains practical information on the handling of radioactive substances, from ordering to waste management and cleaning of the laboratory premises. Together with training in radiation safety, written routines and the annual radiation safety round, the local radiation protection regulations form a unit that guarantees a safe and secure working environment.

Prerequisites for working with radioactive substances

This chapter describes what must be in place before work on radioactive substances begins at Karolinska University Hospital's area. Contact Nuclear Medicine for advice and guidance.

Local license

Work with radioactive substances within the hospital's area may only be carried out at workplaces that have received a local license from the Department of Nuclear Medicine under ME Medical Radiation Physics and Nuclear Medicine (ME MSF NM).

The local license regulates:

- which radioactive substances and amounts of activity may be purchased, handled, and held
- conditions for possible releases of radioactive substances
- the classification of the laboratory into a level indicating the risk
- categorization of workplaces and staff

The meaning of the level and category divisions is described in more detail below.

Radiation safety round

Personnel from Nuclear Medicine conduct an annual radiation safety round of workplaces that have an active local license. During the radiation safety round, it is ensured that the conditions for holding the license are met. The round is a requirement for the license to be renewed.

Person in charge

For each local license, there must be a person in charge appointed, who is responsible for ensuring that there are routines that ensure that the permit requirements are met regarding:

- no radionuclides other than those granted in the license are used
- never handling or storing more than the maximum permitted amount of activity
- registers are kept of purchased radionuclides
- the possession of radionuclides is reported annually in connection with the radiation safety round
- changes that mean that the license needs to be adjusted are reported to Nuclear Medicine
- the work with radioactive substances is only carried out in the premises specified in the license
- all personnel working with open radiation sources have adequate radiation safety training
- all personnel have access to suitable radiation protection equipment
- personal dose and contamination measurements are performed according to instructions
- radioactive waste is disposed of in a manner that complies with the instructions in these regulations
- all radiation-related accidents and deviations are reported
- one of the staff is appointed as a contact person for Nuclear Medicine. i.e. Radiation protection supervisor (Radiation Safety Assistant KI)

Radiation protection supervisor (contact person or Radiation Safety Assistant KI)

For each local license, the person in charge must appoint a radiation safety representative. The tasks of the Radiation protection supervisor are to:

- issue local instructions for work with radionuclides such as purchasing, storage and waste routines and where and how the work is to be conducted
- issue local cleaning instructions to cleaning managers and cleaning staff that ensure that they are not

at risk of being exposed to contamination or external radiation from the radionuclides that are handled

- monitor the purchase of radionuclides and record these to ensure that the maximum holding under license is not exceeded
- order and manage personal dosimeters and personal dose reports (if used)
- maintain up-to-date documentation of all information relevant to reliable radiation safety in the laboratory
- maintain a list of the staff who work with open radiation sources in the lab, including accounting of completed radiation safety training for each person
- ensure that staff read the radiation safety documentation and know where it is available
- make sure that the personnel have read the local radiation safety regulations with a signature on the personnel list
- ensure that radiation-related deviations are reported to Nuclear Medicine
- report to Nuclear Medicine when premises are to be cleared from use of radioactivity.
- ensure that all new personnel receive a go-through of radiation safety in the lab, including how to work radiation-safe and how the radiation protection equipment works.

Risk assessment (level 1–4)

All laboratories that work with open radiation sources are divided into levels by Nuclear Medicine. The level is based on the total possession of radionuclides and how much of each radionuclide is used at each instance and thus becomes a risk assessment of the handling of radioactive substances in the activity in question. Levels 1 to 3 are active licenses, which means that active work with radioactive substances is carried out, but with different risk levels. Level 4 is an inactive, dormant license that may only be held for one year before it is to be deregistered. In summary, the levels can be described as follows:

- Level 1 - Extensive work
- Level 2 - Laboratory work
- Level 3 - Low-level laboratory work
- Level 4 - Dormant license

The level division is the basis for how staff and premises are categorized (see below).

Categorization

The Swedish Radiation Safety Authority (SSM) requires that both personnel working with open radiation sources and the premises where this work is carried out be categorized. At the hospital, staff from Nuclear Medicine perform the categorization and the current division of your lab can be found in the local license.

Categorization of staff

Personnel can either belong to category A, B or be non-categorized. Most people who work with radioactive substances in laboratory activities at the hospital belong to category B.

CATEGORY A

If there is a risk that the staff may receive an effective dose exceeding 6 mSv per year or an equivalent dose to the fingers that exceeds 150 mSv per year, the employee must be classified as category A.

For category A staff, you must:

- carry personal dosemeters with a measurement period of 4 weeks
- renew health certificate annually via occupational health care.

CATEGORY B

If the effective dose is expected to exceed 1 mSv / year but less than 6 mSv / year, the employee must be classified as category B. For employees belonging to category B, dose estimates and control routines must show that the placement in category B is correct. This assessment is made by hospital physicists at Nuclear Medicine at the annual radiation safety round.

Categorization of premises

All rooms where open radiation sources are usedor stored, are classified according to the nature of the work. Premises are classified as either controlled or protected areas. Most of the premises within the hospital, where work with open radiation sources takes place, are protected areas.

FOR A CONTROLLED AREA THE FOLLOWING APPLIES:

- there is a significant risk of contamination
- workers usually belong to category A.
- it is necessary to prevent, or closely monitor, access to the area by unauthorized staff or guests
- the area must be delimited and marked with statutory sign
- written rules for the area must exist and be well known by the staff

FOR A PROTECTED AREA THE FOLLOWING APPLIES:

- there is a risk of contamination
- personnel working in the area usually belong to category A or B.
- there must be statutory signs
- access must be restricted
- the staff must have good knowledge of written or oral rules for the area.

Personal dose monitoring

All personnel belonging to category A must wear a personal dosimeter at four-week intervals. Other personnel may also need to wear dosimeters, personnel from Nuclear Medicine make this assessment. In some laboratories, it may also be considered necessary to measure eye and finger doses regularly or as a temporary check.

Pregnant or breastfeeding staff

If personnel working with ionizing radiation are pregnant, this must be reported as soon as possible to Nuclear Medicine. A written statement is issued regarding the pregnant woman's work situation to ensure that the dose to the fetus does not exceed 1 mSv during the remaining pregnancy. In some cases, it is necessary to avoid certain work tasks to minimize the dose to the fetus. Pregnant women have the right to refrain from working with ionizing radiation during pregnancy if desired.

Breastfeeding staff should contact Nuclear Medicine for investigation and advice.

Training routines in radiation safety

The national authorities stipulate that all personnel working with open radiation sources must have undergone basic radiation safety training at their workplace. In the hospital area, therefore, all personnel must, before starting work with radionuclides:

1. read the local radiation safety regulations (this publication) and sign
2. have a local radiation safety go-through in the lab together with the contact person
3. carry out Karolinska's Web - based radiation safety training

In addition, during the first year, staff must attend a basic radiation safety lecture given by Nuclear Medicine.

This should be repeated every 5 years. The education is documented in the hospital's education portal *Lärtorget.*

The person in charge at each laboratory is responsible for ensuring that all personnel working with open radiation sources have undergone training and that this is recorded. To help them, managers at Karolinska University Hospital can see lists of their staff's educations in the education portal.

General radiation safety documentation

At the hospital, the *Centuri* document management system is used for radiation safety-related documentation, relevant documents are available via *Inuti* (search for radiation safety). In addition to this, laboratory-specific radiation safety documents must be stored in a separate digital or binder-based documentation system (see special section with guidelines for documentation). An annual review of the documentation shall take place at the radiation safety round.

Guidelines for work with radionuclides

This chapter describes general radiation protection principles and practical work rules for safe handling of open radiation sources.

Protection against external radiation

When working with radioactive substances, the risks of external radiation must be minimized. External radiation means that the radiation source is only outside the body. The size of the radiation dose depends on several factors, including:

TIME

The external radiation is directly proportional to the time you spend in the radiation field. **A doubling of the time thus means a doubled radiation dose.**
Keep in mind to:

- work quickly, safely and methodically
- practice new and difficult steps in advance with non-radioactive materials

DISTANCE

"Inverse square law" means that the intensity of the radiation decreases inversely proportional to the square at the distance. **If the distance to the radiation source is doubled, the radiation dose is reduced to a quarter** and if the distance is tripled, the radiation dose is reduced to one-ninth.
Keep in mind to:

- work at the greatest possible distance from the radiation source
- use pliers, tweezers or other distance tools when handling radioactive substances
- Avoid touching unprotected containers containing radioactive material directly with your fingers.

SHEILDING

The intensity of the radiation can be reduced by appropriate shielding.
Suitable material depends on the type of radiation and the thickness is determined by the energy.

Radiation	Energy	Sheilding
β	<300 keV (ex ^{3}H,^{14}C, ^{35}S)	None
β	> 1 Mev (ex ^{32}P)	10 mm perspex
γ	<200 keV (ex ^{125}I, ^{99m}Tc)	2 mm lead

Dimensioning of shielding for higher energies is designed depending on activity and energy.
Contact Nuclear Medicine for advice on these issues.
Keep in mind to:

- If possible, work behind a radiation shield (it also protects against splashes).
- Use spray protection when working with gamma radiation.
- Store radioactive preparations behind a radiation shield.
- Avoid touching unprotected containers containing radioactive material directly with your fingers.

Protection against internal radiation

Spills and external contamination easily lead to internal irradiation of the body's organs by the radioactive substance entering through the skin, mouth, or nose. Contamination can also lead to misleading measurement values and research results. How large the radiation dose becomes in the event of an internal contamination depends, among other things, on these factors:

- activity and radiation
- chemical form of radionuclide
- how the radionuclide is metabolized
- effective half-life

The chemical compound that contains the radionuclide is crucial for its excretion and distribution in the body. This together with the physical radiation properties is decisive for how large the radiation dose becomes to individual organs and to the whole body.

Work rules to minimize the risk of internal radiation are:

- storage and consumption of food and drink, smoking and snuffing are prohibited in laboratories where radioactive substances are stored or used
- absorbent paper with a plastic backing should be used as a base on all workbenches
- volatile substances must be handled in fume cupboards. Read carefully whether the substance you are handling can become airborne during certain handling. May apply, for example, during incubation or when mixing with any chemical substance
- wear protective clothing and gloves and, if a risk of splashes, also eye and hair protection. Change gloves frequently and wash your hands after finishing work
- after completion of work, work surfaces, equipment, protective clothing, and hands must be checked for contamination with a suitable radiation protection instrument

Note that the short range of alpha and beta radiators makes the external radiation easy to shield. However, when these substances enter the body, the short range means that the radiation is absorbed locally in the tissues and that the radiation dose can be large.

Protection against skin contamination

Spills of concentrated radioactive solutions on the skin can give rise to locally high radiation doses. This is especially true for alpha and beta emitters that emit their energy locally.

- Always wear gloves, at high radioactive concentration use double gloves.
- Wash your hands after finishing work.
- After completion of work, work surfaces, equipment, protective clothing, and hands must be checked with a suitable radiation protection instrument.

For handling skin contamination, see section *Measures in case of accidents*.

Contamination control

The requirement for contamination control differs depending on the level at which the laboratory is divided.

- Level 1: Contamination control when leaving the lab, both staff and premises.
- Level 2: Regular contamination checks of premises. Staff are checked when leaving the lab.
- Level 3: Contamination control if necessary, when contamination is suspected.

Contamination checks must be documented if contamination is present. Furthermore, documentation of contamination control of premises must always be documented if the laboratory is used by several groups or

persons not familiar with each other's work.

For all laboratories, materials that leave a controlled or protected area must be checked for contamination.

With radiation protection instrument (not for ^{3}H)

Radiation levels must be checked routinely both within and around all controlled and protected areas to ensure good working conditions.

Use a functional and suitable radiation protection instrument for the task. After finishing work, work surfaces and work clothes should be checked. Materials are measured in connection with it leaving the room.

- Always start by checking the background value in a place where no contamination can occur.
- Measure the workplace, person or material and compare with the background value.
- If values higher than the background value are measured, it is likely that contamination is present, decontaminate according to section *Measures in the event of an accident*. The limit value for contamination is 40 kBq / m2 for beta and gamma-emitting radionuclides and 4 kBq / m2 for alpha-emitting radionuclides.

With Wipe test

Checking of 3H is always performed by wipe tests which are read out in a beta counter. Other beta-emitters with low energy can also be checked by wipe tests (e.g. 14C, 33P and 35S).

- Write a numbered list of the places or objects where sampling is to be performed and mark the sample jars with the respective numbers.
- Take a swab with clean tweezers. Wet the patch with alcohol or scintillation fluid.
- If the sampling is done on a larger surface, measure 10 x 10 cm, or for smaller objects: measure the current surface. Pull the swab over the surface with even strokes in one direction. Do not swab the same surface several times.
- Place the swab in the marked scintillation jar and make sure the number matches the numbered list. Perform this step on any surface that may be contaminated.
- Repeat the same steps as above, but in an area that cannot be contaminated (background). If possible, make sure that the area is about the same size as your test areas.
- Measure the samples in a beta counter. The limit value for contamination of 3H is 40 kBq / m2. Assume that you will not remove all contamination with the swab. For instance, it could be reasonable to assume that only 10% of the actual contamination is measured in the sample.

In the event of contamination, see section *Measures in case of accidents*. Furthermore, the contamination must be documented.

Report to Nuclear Medicine if contamination still exists after decontamination.

Ventilation

Workplaces that use radionuclides that can become airborne, such as radioactive iodine, must ensure that controls on the ventilation in the workstation are performed:

- Before starting work, the workstation (fume cupboard, etc.) should be tested so that it works properly.
- In laboratories with reduced air pressure in the premises, the meter for the workstation must be tested at least every six months and the result must be documented.

Practical radiation safety

When working with open radiation sources, there are several work rules that must be followed. The rules below are general and mainly apply to workplaces that are divided into level 1 or 2, but certain parts are also

applicable for level 3. For each workplace, special rules, specific to the space and type of work, must also be available to all staff.

1. Wear protective gloves. Change often. Always wash your hands after work. In case of risk for splashes, also protective coat, hair, and eye protection.
2. Always treat protective gloves as radioactive waste if they are not checked with a radiation protection instruments.
3. Cover work surfaces with absorbent paper with a plastic backing. Change regularly.
4. Label bottles, vessels, etc. with radionuclide, activity, and time of specified activity.
5. It is strictly forbidden to eat, drink, chew gum, snuff or store food in rooms where open radiation sources are handled.
6. Work quickly and methodically. Avoid spills. Train new and difficult work steps without radioactivity.
7. Work at the greatest possible distance from the radiation source. Avoid touching directly on bottles, syringes, etc. that contain activity. Use remote tools such as pliers or tweezers.
8. If possible, work behind a Perspex shield when working with beta emitters and lead or lead glass when working with gamma emitters.
9. Use syringe-shield when withdrawing radioactive substances into a syringe or injecting them.
10. Store radioactive material behind the radiation shield. Various types of containers and screens made of Perspex or lead are available on the market.
11. Work in a fume hood if there is a risk of airborne activity (gas, steam, splashes, dry radioactive substances).
12. Check work surfaces, tools, protective clothing, and hands with radiation protection instruments after finishing work with radionuclides.
13. Dispose of any radioactive waste as soon as possible after the end of the work. Leave the laboratory clean, neat, and tidy.

Changed or discontinued operations

If a laboratory that holds a local license ceases to use radioactive substances, this must be reported to Nuclear Medicine.

If you change premises for work with radioactive substances or stop using premises for this type of work, this must also be reported to Nuclear Medicine. Nuclear Medicine will perform control measurements of the premises before they can be used for other work.

Handling routines

This chapter describes special handling routines required for ordering, storage, waste, transport, and deviations when working with open radiation sources.

Ordering and delivery

Radionuclides intended for administration to human

1. Orders are placed primarily via the Radiopharmaceutical Laboratory (RFL)
2. The radionuclides not supplied via RFL are ordered directly from the manufacturer and delivered directly to the department.
3. The preparations must be registered and measured by the receiving working group.

Radionuclides for other use

1. In order not to exceed the total amount in the license, all purchases must be monitored and / or handled by the radiation protection supervisor/ contact person.
2. Ordering is done directly from the supplier.
3. Ordered preparations are delivered directly to the department/laboratory.

Purchased radionuclides are recorded by the laboratory's radiation protection supervisor, indicating the radionuclide, reference date and activity. The documentation can, as a suggestion, mean saving signed delivery notes. This documentation must be available to be reported to Nuclear Medicine on request.

Storage

1. Radioactive substances must be stored in a locked room, department, or cupboard.
2. Radioactive substances must be stored in a manner that is safe from a fire protection point of view.
3. Radioactive material must be labeled with information on radionuclide, amount of activity and time of specified activity.
4. Storage areas must be marked with warning signs. This also applies to radioactive waste. Signs can be obtained from Nuclear Medicine.

Transportation of radioactive substances

Internal transports

Radioactive material may be transported indoors through the hospital's premises. The transport must follow these rules:

1. Radioactive material must be labeled with information on radionuclide, amount of activity, time of specified activity and laboratory number or contact person.
2. Radioactive materials must under no circumstances be left unattended during transport.
3. All packaging must be well sealed, and radiation shielded to avoid contamination or unnecessary irradiation. Consider in advance how the packaging would handle a fall or a collision and reinforce

with additional packaging if necessary.

4. Transport should preferably take place on a trolley or transport bicycle to maximize the distance to the radiation source.
5. In the event of an accident during transport, the site should be monitored to prevent personal contamination and the spread of radioactive material. Contact a medical physicist at Nuclear Medicine immediately, without leaving the site. (Telephone must always be included in internal transport.)

External transports

External transport on public roads may only take place with an authorized transport company. External transport of radioactive substances is regulated in the Swedish Civil Contingencies Agency's (MSB) regulation on the transport of dangerous goods (ADR-S).

Radioactive Waste

Liquid Waste

- Liquid waste must primarily be handed in to the delivery room for radioactive waste in BioClinicum (J2) floor 2 (room U220023100) in Solna or C2:3709 in Huddinge. The packages must be well sealed and marked with laboratory number, contact person, telephone number, radionuclide, activity, and date of activity estimate.
- A laboratory that wants to pour permitted amounts of activity into the sewer system must first contact Nuclear Medicine for approval. As a rule, only one sink per laboratory is approved. The sink must be marked with the sign "Discharge site for liquid radioactive waste" and an instruction on which radionuclides may be released and in which activity amounts. After discharge, plenty of water should be flushed down the drain.
- Scintillation solutions must be packaged in accordance with the hospital's rules. If the radioactivity exceeds the stated limit values (e.g. 100 kBq / kg for H3 and 1 kBq / kg for C14), the container must be marked as both chemical and radioactive waste and delivered to the hospital's waste room for radioactive waste. If the amount of radioactivity is lower than the limit value, it can be treated as only chemical waste according to the hospital's internal routines.

Shielded radioactive sources

Reference radiation sources or other shielded radiation sources no longer in use, are disposed of in accordance with the current waste plan for radioactive waste. Note that some instruments, e.g. automatic liquid scintillation counters (β-counters, γ-counters), may contain a radiation source. When such an instrument is to be discarded, the radiation source must first be removed and handed over to Nuclear Medicine. Contact Nuclear Medicine before leaving a shielded radiation source to the radioactive waste room.

Biological waste

Radioactive animal bodies / organs / tissues must be packed in a black plastic box intended for biological waste. Label for radioactive waste with correct information about radionuclide, date, approximate amount of activity and the name and telephone number of the submitter is pasted on the box together with the label "biological waste". Plastic box and label "Biological waste" ordered from MediCarrier.

The waste must be stored frozen, so contact a Nuclear Medicine before placing it in the radioactive waste room. This is important to prevent the freezing chain from breaking. When the radioactivity has decline enough to handle as normal waste, the laboratory will collect the waste and discard of it according to routines for biological waste. In Huddinge, there is currently no possibility to store biological radioactive waste.

Plastic- and lead containers

Empty plastic and lead containers must never be discarded without removing labels and tape that incorrectly indicate that the contents are radioactive. Lead containers can be handed to Nuclear Medicine, and plastic containers can be discarded in the usual way after the radioactive markings have been removed. Contact staff at Nuclear Medicine if you want to hand over lead containers.

Other Radioactive Waste

Other liquid and solid radioactive waste must be placed in a green plastic box (50 liters) for special waste. The container is marked with a label with the laboratory's identity number and the label "Radioactive waste" filled with the following information:

- sender (laboratory)
- signature (submitter's)
- telephone number
- date
- nuclide
- estimated amount of activity.

ACCESS

A SITHS-card (E-tjänstekort) is required for access to the waste room in Solna. Authorization for door passage on the card is then applied for via *Navet* (Dörrpassage Solna (NKS) -> Radioaktivt Avfall), justify the application by entering the lab number.

Each package may not exceed 100 MBq H3 or 10 MBq C14. There is no such restriction for other radionuclides. However, it is always important that the activity is estimated and stated.

The boxes are transported to the delivery room for radioactive waste on the 2nd floor of the BioClinicum, where they are registered in the digital system for waste documentation "RadWaste", according to separate instructions.

For access to waste rooms in Huddinge, contact the medical physicist on duty at Nuclear Medicine in Huddinge.

Waste labels are distributed by Nuclear Medicine. Green plastic box for radioactive waste is ordered from Medicarrier.

Estimation of radioactivity in waste

To estimate the amount of activity in a waste package, one should use the total activity in the original stock solution, correct for decay (applies if the storage time is significant compared to the nuclide half-life, T) and make an estimate of the activity amounts given below to subtract these from the total amount of activity.

Correct for decay:

$$A(t) = A(t_0) \cdot e^{-(t-t0)\cdot \ln 2/T}$$

Subtract:

- the amount that may have disappeared as liquid waste / scintillation solution / biological waste etc.
- the amount that may remain in the stock solution or the like.

If several stock solutions have been used for the same waste packaging, these are added.

Measures in case of accidents

Personal contamination

When a person has been contaminated:

1. all contaminated clothing should be removed as soon as possible, do not forget that the shoes may be contaminated
2. remaining clothing and skin are checked with radiation protection instruments
3. contaminated clothing is placed in a well-sealed and marked plastic bag that is left for decay in a radiation-protected place or treated as radioactive waste.
4. contaminated skin should be washed with mild soap and lukewarm water without scrubbing. Remember to never use solvents or rubbing alcohol, which reduces the skin's own protective function
5. the incident is documented in the company's radiation safety documentation.

Continue washing contaminated skin until further washing becomes ineffective when checking with radiation protection instrument.

IF CONTAMINATION STILL REMAINS:

Contact Nuclear Medicine to follow up on the incident:

- the event is reviewed, and the received radiation dose is estimated
- if necessary, the occupational health service is contacted to perform an additional medical examination
- if the annual dose limit is exceeded, the person in question may not continue working with radioactive substances this year.
- local deviation reporting is carried out
- routines and methods are reviewed to minimize the risk of recurrence of the accident.

Area or surface contamination

1. Measure the area with a suitable radiation protection instrument
2. Absorb spillage with absorbent material (liquid) or with soaked absorbent material (powder)
3. Work from the outer edge of the contamination and inwards, never rub as it may lead to contamination of a larger area
4. When liquid or powder is removed as much as possible, wash the surface with lukewarm water and soap repeatedly and check with radiation protection instrument between each wash
5. Repeat this until the degree of contamination no longer decreases

Cleaning materials are placed in a specially designed and marked bag / container for radioactive waste, which is handled according to section *Radioactive waste.*

IF CONTAMINATION STILL REMAINS:

- cover the contaminated surface with absorbing paper with a plastic backing
- measure with radiation protection instruments and note the result on the protective paper
- mark the area with warning tape and write the radionuclide, measured value after decontamination and your name and telephone number
- report the contamination to the personnel concerned
- check all personnel involved in the accident with radiation protection instruments. (See routines

above if personal contamination occurs.)

- report to Nuclear Medicine
- document the contamination in the radiation safety documentation.

Radiation related deviation

Radiation-related incidents and accidents must always be reported to Nuclear Medicine for assessment.

Local radiation safety documentation

Each laboratory must have its own radiation safety documentation, where the documents and measurement protocols that apply to radiation safety in the operation are stored. In each individual laboratory, the following information must be documented, signed, and kept easily accessible to the personnel concerned:

- received and stored radioactive substances with activity and date indicated
- possession of calibration sources or other shielded sources
- personnel list signed when local radiation protection regulations are read
- list of completed radiation protection training
- results of possible ventilation inspections
- results of contamination checks
- results of personal dose measurements
- radiation-related accidents and incidents

Changes regarding radionuclides, amounts of activity, premises, and routines as well as other circumstances, which may affect radiation safety conditions, must be reported to Nuclear Medicine as soon as possible.

Controlled areas

Written routines in the form of local rules must be developed for each controlled area and depending on the nature of the work, also for protected areas. Templates for this can be obtained from Nuclear Medicine.

Cleaning of premises

Cleaning staff must be aware that radioactive substances are handled in the room but do not need to undergo special training in radiation safety. However, the radiation protection supervisor must inform the cleaning staff on the radiation safety in the lab with focus on the following:

- cleaning staff must wear protective gloves.
- cleaning of fume cupboards and benches where open radiation sources are handled is performed by laboratory personnel.
- the cleaning staff must recognize warning markings around contaminated areas.
- the cleaning staff must know where / what they are allowed to clean and where radioactive substances and waste are located in the laboratory.
- radioactive waste must not be handled by cleaning staff.