 LUND UNIVERSITY Lund University Bioimaging Center	General Radiation Safety Rules for work in PET/SPECT/CT facility BMC A09	
	Prepared by: Marie Sydoff	Approved by: Freddy Ståhlberg
	Counter-signed by: Ritha Gidlöf	Latest updated: 2018-03-12 Valid from: 2018-03-12

GENERAL


For the safety of everyone who will be working with radiation in the PET/SPECT/CT unit in BMC A09, the following rules have to be strictly followed.

It is the duty of the each research group leader, as well as the responsible scientist to ensure compliance with the rules. Failure to adhere to these rules may result in the termination of the study by LBIC.

These radiation safety rules are prepared according to the SRSA's (Swedish Radiation Safety Authority = Strålsäkerhetsmyndigheten) SSMFS2008:28

Contents

1 Radiation Safety Staff.....	3
2 Permit and classification.....	3
3 Radiation safety education	4
3.1. For the responsible scientist.....	4
3.2 Working with radiation during pregnancy	4
4 Introduction in the facility	4
5 Ordering and transportation of radioactive materials	4
6 Instructions for work with open radiation sources.....	6
7 Instructions for handling of radioactive animals	6
7.1. Transportation of radioactive animals.....	6
7.2. Injection and dissection of radioactive animals.....	7
7.3. Handling of radioactive cages	7
8 Instructions for handling of radioactive waste	7
8.1. Handling of liquid radioactive waste	7
8.2. Handling of non-biological radioactive waste	7
8.3. Handling of biological radioactive waste	8
9 Instructions for handling of radiation accidents	8
10 Instructions for calibration and use of radiation surveillance instruments	9
11 Instructions for records and documentation.....	9
11.1. Documentations made by the scientist.....	9
11.2. Documentations made by LBIC staff	9
12 Routines for cleaning	10

 LUND UNIVERSITY Lund University Bioimaging Center	General Radiation Safety Rules for work in PET/SPECT/CT facility BMC A09	
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13 Routines for inspection.....10


Appendix:

SSM regulations

[https://www.stralsakerhetsmyndigheten.se/](https://www.stralsakerhetsmyndigheten.se/contentassets/6376a2abda364a2485109ee70c59c99d/ssmfs-200828-stralsakerhetsmyndighetens-foreskrifter-om-laboratieverksamhet-med-radioaktiva-amnen-i-form-av-oppna-stralkallor-)

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stralsakerhetsmyndighetens-foreskrifter-om-laboratieverksamhet-med-radioaktiva-amnen-i-form-av-oppna-stralkallor-

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1 Radiation Safety Staff (Lokal strålskyddsansvarig/kontaktperson)


LBIC's radiation safety officer, Marie Sydoff, marie.sydoff@med.lu.se; telephone: 046-222 05 41 has the overall responsibility that the radiation-related works carried out in the unit follow the established regulations and rules.

2 Permit and classification

All radioactive works carried out in the PET/SPECT/CT unit will be classified as *extensive work* (omfattande arbete) as soon as the handling is exceeding the activity limits given below per each performance (arbetsmoment) (see tables).

Table 1. Classification of radionuclides according to their radiotoxicity (half-life)			
Class A (very high toxicity)	Class B (high toxicity)	Class C (moderate toxicity)	Class D (low toxicity)
Not allowed in our facility	Na-22 (2.6 years)*	F-18 (120 min)	C-11 (20 min)
	In-114m (50 d)	Y-90	Tc-99m (6 h)
	I-131 (8.0 d)	In-111 (2.8 d)	
	I-124 (4.2 d)	Lu-177 (6.7 d)	
	I-125 (60 d)*		
	At-211 (6 h)		
	Tl-204? (12.2 d)		
*Note that Na-22 is only reserved for calibration of the camera (handled by LBIC staff) and stored in a safe place. Handling of long-lived isotope as I-125 has to be consulted with radiation safety officer			

Table 2. Limits of activity per each performance from different classes			
Type of performance	Activity (MBq)		
	Class B	Class C	Class D
Risk for internal contamination when using isotopes in powder or in gas form	1	10	100
Risk for external and internal contamination using radioactive solutions, e.g. performing injections	10	100	1000
Small risk for external and internal contamination such as preparing syringes from the stock solutions in the hood	100	1000	10 000

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3 Radiation safety education

3.1. For the responsible scientist

It is mandatory that everyone who will be working in the PET/SPECT/CT facility (i.e. the person who is present at the imaging experiment) has received radiation safety education. The date of the education occasion has to be recorded for each responsible scientist/person. Such education can be renewed after a period of time if required/desired. Persons with radiation safety education elsewhere and/or persons with a medical physicist degree who do not wish to renew the education have to go through the instructions of how to use radiation surveillance instruments.

After the radiation safety education, the person should have received:

- information about the risks when working in a *restricted* area
- instructions for handling of radioactive materials regarding to its radiation safety aspects
- instructions of how to use radiation surveillance instruments

3.2. Working with radiation during pregnancy

Working with radiation during pregnancy is allowed but under special circumstances (dependent on the type of isotopes, the amount of activity, handling procedures and how far in the pregnancy). We recommend you to discuss with LBIC's radiation safety officer prior to each experiment.

4 Introduction in the facility

It is mandatory that everyone who will be working in the PET/SPECT/CT facility (i.e. the person who is present at the imaging experiment) has received radiation safety education and an introduction in the facility.


The mandatory introduction in the facility is to ensure that each individual responsible scientist prior to the actual experiment knows:

- the location of emergency exit
- the location of police alarm
- the location of eye wash, emergency shower
- routines and rules of the changing zone before entering in the laboratories
- the rules for animal storage and handling
- the rules for waste handling

The introduction should be renewed after one year of inactivity.

5 Ordering and transportation of radioactive materials

- Radioactive materials are defined as radionuclides or radiotracers that are to be delivered to the PET/SPECT/CT unit for experiments (i.e. for injections in animals or for measurement of other kinds).
- The responsible scientist is responsible for purchase of radioactive materials. Contact our radiochemist Ritha Gidlöf for help with the purchase if needed.

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All orders have to be processed through the radionuclide central (radionuklidcentralen, RNC). For transportation of the radioactive materials into the PET/SPECT/CT facility, the staff has to be contacted prior to the experiment.


All radioactive materials are ordered and delivered in different ways:

- Radioisotopes that are ordered by RNC: RNC contacts the user (användaren/beställaren) when the package has arrived. The user goes there and receives the package. The user brings the package to the radiochemistry laboratory at LBIC, BMC D11 or elsewhere (authorized for radioactive work) to dismount the package or for further radiolabelling of cold substances before it is delivered to the PET/SPECT/CT facility.
- Radiotracers (labeled substances, i.e. ^{18}F FDG, ^{18}F -choline) or radioisotopes (eluted from generator or produced at the cyclotron unit) that will be delivered to the PET/SPECT/CT unit can be directly transported in suitable lead shielding (see Figure below).



Transportation and receiving of radioactive materials:

- Inspect that there is no leakage from the container.
- Make sure that the content declaration is correct.
- After further processing (i.e. dispensing or radiolabelling from a stock solution), label the new tubes/flask properly with isotope, activity, date, time and always label the package/lead container (blyburk) with tape with a radioactivity sign.
- All radioactive materials which will be delivered to the PET/SPECT/CT unit have to be delivered through the “radiotracer slot” (genomräkningslucka), which only the staff has access to. Therefore it is mandatory that the responsible scientist has to contact the staff to arrange this. Upon agreement, the staff will be waiting (if the staff is not the person who delivers) at the radiotracer slot to receive the delivery and put it into the box.

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- When the box is closed from outside, the box can be opened from inside. The lead container is disinfected with ethanol (available close to the box). The radioactive materials are transported into the preparation room, in the designated hood for further dispensing.

Logging (journalföring):

- All radioactive materials that are taken into the unit have to be recorded in a log book (on the shelf close to the radiotracer slot). The following information should be properly written: Date, supplier, radioisotope, activity, volume and signature of the person receiving the radioactive materials.

Storage of radioactive materials

- The radioactive stock solutions shall be stored in the designated areas, marked with "Storage for radioactive materials". The solution should be stored and kept in the lead container that came with the delivery, which will give a good radiation shielding. If not possible, the solution has to be placed behind lead shielding in the hood.


6 Instructions for work with open radiation sources (öppna strålkällor).

- All work with open radiation sources (dispensing, preparation of syringes etc) should be performed in the hood behind lead shielding.
- Do not work with radioactivity if you have open wounds on your hands or arms
- Always use absorbing plastic papers on the bench before you put any radioactive materials on it.
- Always work in a ventilated area or in the hood if possible
- Always use protective gloves. Always take off the gloves before you touch anything (for examples door, telephones, pens etc)
- Use goggles when possible and use adequate radiation shielding (lead shielding)
- Label properly with type of isotope, date, activity and your name
- **It is strictly forbidden to eat, drink or chew gums in the laboratories**
- Clean after yourself and always check the surfaces with a contamination detector.

7 Instructions for handling of radioactive animals

7.1. Transportation of radioactive animals

- No animals will be brought back to their original animal rooms directly after scanning. Depending on the amount of activity and the type of isotopes (short- or long-lived), the radioactive animals will be stored in

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the radioactive animal rooms (B8 or B9) and will be declassified from radiation before they are allowed to be transported back to their original rooms. Declassification is done by LBIC staff or by **dedicated animal staff**.

- Transportation of radioactive animals will be performed with the help of LBIC staff or dedicated animal staff.

7.2. Injections and dissection of radioactive animals

- Prepare the syringes in the hood. Measure the activity in the dose calibrator next to the hood. Always cap on the syringes and put the syringes in lead shielding until injections
- Injections of animals are performed on designated area, on the ventilated bench
- Dissection of radioactive animals is performed on designated ventilated dissection bench.
- Always use absorbing plastic paper and put the animals on this paper to avoid contamination on the bench.
- Always wash and clean the dissection tools after your work and leave them at the sink in the preparation room for sterilization
- Always put an absorbing plastic paper on the animal bed before positioning the animal for scanning

7.3. Changing animal cages

- Cages with possibly contaminated bedding materials have to be measured for radioactivity using a hand detector. If the cages are not radioactive, they can be left in the dishes. If they are radioactive, they have to be decayed and declassified from radiation by LBIC staff. Always note the date, isotope and your name on any cages left in the lab.


8 Instructions for handling of radioactive waste

8.1 Handling of liquid radioactive waste

- All liquid radioactive waste (such as stock solution) is kept in lead container and is put for decay on a designated place. Always note the date, isotope, amount and your name on the container.
- No liquid waste is allowed to be discarded in the sink or anywhere.

8.2 Handling of non-biological radioactive waste

- Non-biological radioactive waste is for instance papers, towels, absorbing papers, gloves, syringes and other materials that have been used in the work with radioactive materials and therefore might be contaminated.

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- Contaminated non-biological radioactive waste is discarded in the lead waste container. This one is composed of a plastic bag which is put in a paper waste box (riskavfallskartonger) in the size of 55L.
- Sharp and cutting waste, such as needles and razors are put in a designated yellow plastic container that is placed in the hood. When the container is full, the whole container is discarded in the lead waste container.
- When the lead container is full, it will be transported away for decay in the decay room (C15) or sent away for destruction if the level is not too high. The container to be sent/put away has to be properly labeled with sender's name, type of waste, dominating radioisotope and with full declaration on the yellow pre-printed "radioaktivt avfall". This label is put on the outside of the waste box. If the box contains sharp and cutting waste, it should also mark it on the box. This is done by the PET/SPECT staff.

8.3 Handling of biological radioactive waste


- Biological radioactive waste is radioactive cadavers of any kind (whole dead animal bodies or parts of animals).
- Biological radioactive waste is put in a plastic bag. A fully written declaration has to be made and put on the plastic bag for all radioisotopes with a half-life over 10 h. The label should contain: radioisotope, date and estimated activity.
- This is then put in the freezer in the right box for decay.
- The radioactive cadavers will be declassified from radiation and sent away for destructions regularly by the LBIC staff

9 Instructions for handling of radiation accidents

- In case of a radiation accident, our radiation safety officer has to be contacted immediately.
- All accidents have to be reported to our radiation safety officer and a report of the accident has to be written.

Decontamination

- If radioactive spill occurs, the contaminated area has to be marked (e.g. with tape) and thorough decontamination work has to be performed. Immediately contact our radiation safety officer Marie Sydoff.
- Minimize the extent of the contamination if this can be done without risk for extra radiation dose to any person.
- The contaminated area is cleaned and dried with absorbing papers. Start working from outside and inwards of the contaminated area.

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- Contaminated skin and hair has to be thoroughly washed with soap and water
- Use the eye shower in the preparation room if necessary
- Use the emergency shower in the preparation room if necessary
- Monitor everything with radiation surveillance instrument
- Change lab coat if radioactive spill on the clothes. Contaminated lab coat is put in a plastic bag and put away for decay.

10 Instructions for calibration and use of radiation surveillance instruments

- After the radiation safety education you should have received information on how to use the radiation surveillance instruments.
- If unclear, please see the manuals in the “Rules & Safety” folder or consult our radiation safety officer
- The radiation surveillance instruments are available in our laboratories.
- A contamination monitor is attached on the wall close to the sink. This one is used for detecting possible contamination on your clothes before leaving the facility. There is another one for detecting contamination on the surfaces. This one is put in the preparation room for recording of the background level before and after work.
- There is a hand detector to measure the dose rate from a radiation source.
- Extra lead bricks are available in the preparation room for shielding.
- Lead shields (blyburkar) for samples and syringes are available under the CO₂ hood.


11 Instructions for records (journalföring) and documentation

11.1. Documentations made by the responsible scientist

- Before commencing your work, measure the surfaces for possible contamination. If contamination found please contact LBIC staff.
- Note the background level in the log book before commencing your work
- After work, monitor the surfaces and the background level and make a note in the log book.
- When receiving radioactive materials (stock solutions) from the radiotracer slot, make a note of the type of isotopes, amount of activity, time, date, and your name in the log book
- When putting cadavers for decay, make a note on the freezer

11.2 Documentations made by LBIC staff

- Records of contamination, unexpected accidents

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- Records of each person that have received radiation education and introduction
- Records of the date of quality control of the radiation surveillance instruments

12 Routines for cleaning

- The PET/SPECT/CT facility is cleaned by the LU service trained staff
- The cleaning staff has received instructions for cleaning in the restricted area. Cleaning is performed twice a week, at 08.00 in the mornings (when there is no activity)
- The cleaning supplies are stored in the cabinet in the corridor.
- Extensive cleaning occurs every 6 months.

13 Routines for inspection

13.1 Internal inspection

- The rules and routines are always available in a folder name "Rules & Safety" in each laboratory for our researchers.
- The rules and routines are regularly updated, if not required: once/year.

13.2 External inspection

- These radiation safety and rules are prepared according to the SRSA's (Swedish Radiation Safety Authority = Strålsäkerhetsmyndigheten) SSM FS 2008:28
- LBIC has an annual external inspection by the LU radiation safety organization.