

Standard operasjonsprosedyre:

SOP nr: 18-02

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Revidert av:

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## USE OF THE DU-026 CT/MR ROOM

### 1.0 PURPOSE

- 1.1 To ensure that everyone follows the Regulations on Radiation Protection and Use of Radiation and the regulations issued by DSA (the Norwegian Radiation and Nuclear Safety Authority).
- 1.2 To prevent people and the environment being exposed to unnecessary radiation.
- 1.3 To prevent injuries.
- 1.4 To prevent damage to machines and equipment.
- 1.5 To safeguard good animal welfare.
- 1.6 To safeguard good health and safety procedures in a multi-purpose room containing machines with different safety requirements.

### 2.0 DIVISION OF RESPONSIBILITY

- 2.1 Everyone who uses room DU-026 must be thoroughly familiar with the contents of this SOP.
- 2.2 The HSE coordinator is responsible for updating this SOP when needed and for gathering information about the machines.
- 2.3 The person in charge of equipment informs the head of department and the HSE coordinator about any orders of X-ray or MR equipment intended for KPM.
- 2.4 KPM users must consult the section manager at KPM before X-ray or MR equipment is ordered to KPM.
- 2.5 The section manager gathers any necessary documentation from the user/producer concerning the requirements governing the import and installation of equipment and forwards this to the HSE coordinator.
- 2.6 The section manager is responsible for assessing whether the equipment/machine can be used inside KPM and where it should be positioned.
- 2.7 The section manager is responsible for contacting the HSE coordinator when new machines are to be installed that may pose a risk for personnel and cleaning staff.
- 2.8 The owner of the machine is responsible for informing KPM in good time before the arrival of the machine and for making sure that a user manual is given to the HSE coordinator and the section manager.
- 2.9 The owner of the machine, the section manager, the HSE coordinator and the radiation coordinator must work together to draw up a risk assessment of all new X-ray or MR equipment before it is installed at KPM. The owner is responsible for ensuring that all new X-ray and MR equipment is reported to the DSA. The owner may consult the radiation coordinator, if needed.



- 2.10 The owner must submit to KPM documentation that the installation has been approved by the supplier/producer.
- 2.11 The owner of the machine must ensure that everything is correctly marked in compliance with the user manuals and legislation. The magnetic field (contour plot) must be marked with tape on the floor. Radioactive sources must be labelled with the radiouclide, the activity on a particular date and the serial number.
- 2.12 The HSE coordinator is responsible for door signage and for advising KPM users about this SOP.
- 2.13 The group leader must ensure that his/her employees are thoroughly trained in the use of the machines. Written work procedures must be drawn up. Staff training must be documented and a confirmation that training has taken place must be submitted to KPM. The group leader is responsible for drawing up risk assessments for the machine he/she is using. Written contingency plans must be produced to contend with accidents and unwanted incidents. The procedures must be regularly reviewed and updated.
- 2.14 The group leader is responsible for informing his/her employees about radiation protection courses.
- 2.15 The group leader must ensure that employees are provided with the necessary personal protective equipment.
- 2.16 The owner of the machine is responsible for carrying out status checks and maintenance on the machine. The Quantum GX2 micro CT must be monitored for leaks annually and a report of this must be sent to KPM.
- 2.17 The owner of the machine must make sure that cables are securely fastened so that they do not pose a tripping hazard or danger to cleaning staff.
- 2.18 The group leader is responsible for informing the section manager and the HSE coordinator if machines are replaced or modified. All repairs and adjustments must be carried out by authorized personnel approved by the producer. A report must be sent to DSA if machines are disposed of or moved.
- 2.19 The PMSK is responsible for FOTS applications and animal welfare.

### 3.0 PROCEDURE

- 3.1 Everyone must study the current SOP before being granted access to room DU-026.
- 3.2 The danger sign on the door must be respected.
- 3.3 Only one machine can be used at a time in DU-026. The room must be booked in Science Linker before commencement of the experiment.
- 3.4 Experiments are not permitted in DU-026 before KPM has received documentation showing that thorough training has been given.
- 3.5 The PMSK is responsible for ensuring that only those persons named in FOTS and who can document that they have received the mandatory training are permitted to handle the machines.

Risk assessment in the case of unwanted incidents:

Unwanted incident	Possible consequence	C*P (consequence*probability)
Started experiment without having received adequate training of the machine	<ol style="list-style-type: none"> <li>Components of the machine are destroyed.</li> <li>Exposure to unnecessary radiation.</li> </ol>	<ol style="list-style-type: none"> <li>3*2</li> <li>3*1</li> </ol>

- If machines are damaged, there is a risk of exposure to a high level of radiation, for example if the beryllium window on the CT machine is damaged. Machines with high-voltage cables can cause electric shock if the cables are handled incorrectly.
- The maximum dose of radiation for employees must not exceed 2000 mrem per year (or 20mSv), which is equivalent to ca. 5.4 mrem per day. The machine emits 0,5 mrem per hour and a person will reach the maximum dose when using the machine daily with continuous exposure for 10 hours per day. The risk is therefore low.

3.6 Persons with a pacemaker must not enter DU-026 due to the strong level of magnetism.

Risk assessment in the case of unwanted incidents:

Unwanted incident	Possible consequence	C*P (consequence*probability)
Person with pacemaker or ICD entered the room and got too close to the magnetic field.	The magnetic field interferes with the pacemaker/ICD functions. This may cause heart fluttering or may deactivate the device. The risk of a stroke and heart failure is heavily increased.	4*1

3.7 Pregnant women or those planning to become pregnant must consult the group leader and/or the occupational health service about the risks involved in working in this room.

3.8 Persons and animals with metal implants must keep away from magnetic fields.

3.9 Metal and ferromagnetic objects must be kept away from magnetic sources. All metal objects must be kept at a safe distance from magnetic sources and outside the marked area. NB! Check your pockets etc. carefully before handling MR equipment.

Risk assessment in the case of unwanted incidents:

Unwanted incident	Possible consequence	C*P (consequence*probability)
A ferromagnetic object got too close to the MR machine while it was in operation.	A person is injured by a ferromagnetic projectile	4*2

Injuries due to ferromagnetic projectiles can vary – the above example is based on an incident where the object hits soft tissue, such as an eye.

- 3.10 Keep outside the areas marked by striped tape, except when operating the machine.
- 3.11 Keep electronic equipment, storage media and credit cards etc. away from magnetic sources.
- 3.12 Always follow the protocols for the use of the machine and ask for further training if necessary.
- 3.13 Make sure you always use the correct personal protective equipment.
- 3.14 Use a scavenger and suction unit and necessary protective equipment when using anaesthetic gas.
- 3.15 Keep animals that are under anaesthetic under constant surveillance. Make sure that the animals do not become overheated, suffer burns or are exposed to unnecessarily high doses of radiation. Dosage limits must be set for the various procedures.

*Risk assessment in the case of unwanted incidents:*

Unwanted incident	Possible consequence	C*P (consequence*probability)
An animal woke up during a procedure when using the MR machine.	<ol style="list-style-type: none"> <li>1. The animal suffers severe burns from a gradient coil.</li> <li>2. The researcher tries to pick up the animal and gets burned by the coil.</li> </ol>	<ol style="list-style-type: none"> <li>1. 3*3</li> <li>2. 2*3</li> </ol>

- 3.16 Make sure that fans have free clearance to maintain proper cooling of the machine.
- 3.17 Make sure that you mop up any water spillages and that water pipes do not leak.
- 3.18 Any hazardous substances being used, such as «imaging phantom», must be risk assessed. KPM must be informed about such substances.
- 3.19 Make sure that consistency checks are carried out on a regular basis (daily/weekly/monthly). Make a record of any deviations and follow the protocol for addressing these. The machine must be serviced on an annual basis by certified personnel.
- 3.20 If accidents or unwanted incidences occur, the current contingency plan must be followed. The accident/incident must be reported to the DSA within three days at the latest after it occurred. Deviations must be reported in the local CIM.
- 3.21 Contact the supplier if the machine is in need of service or repair. Label the equipment concerned and do not conduct experiments with the machine if it is not in full working order.
- 3.22 Matters regarding experiments involving X-rays and magnetism can be discussed in the Platform. The person to contact per February 2023 is Syed Nuruddin.
- 3.23 Questions about radiation protection can be raised with the Institute’s radiation coordinator.

**4.0 HEALTH, SAFETY AND THE ENVIRONMENT (HSE)**

- 4.1 The group leader must make sure that employees are provided with the necessary personal protective equipment. Employees at risk of exposure to an effective dose of radiation that exceeds 6 mSv per year must use a personal dosimeter.
- 4.2 Employees exposed to an effective dose of radiation of more than 6 mSv per year must have a health check once every three years.

- 4.3 The radiation dose that foetuses are exposed to must not exceed 1 mSv during the remainder of the pregnancy.
- 4.4 The owner, KPM users and the HSE coordinator must read the user manual before they start to use the machine.
- 4.5 All users must be aware of the risks involved in using the machine and the actions to be taken if accidents/unwanted incidents occur.
- 4.6 Kristen Grundt must be consulted about the disposal of radioactive waste.
- 4.7 There must be a clear sign on the door to DU-026 at all times warning of strong magnetism and radiation:



*Strong magnet*



*Radiation*

## 5.0 EQUIPMENT AND MAINTENANCE

- 5.1 Link to the user manual [ICON M2 Compact MRI system](#)
- 5.2 Link to the user manual [Quantum Gx2 Micro CT](#)
- 5.3 Link to the user manual [IconTM system](#)

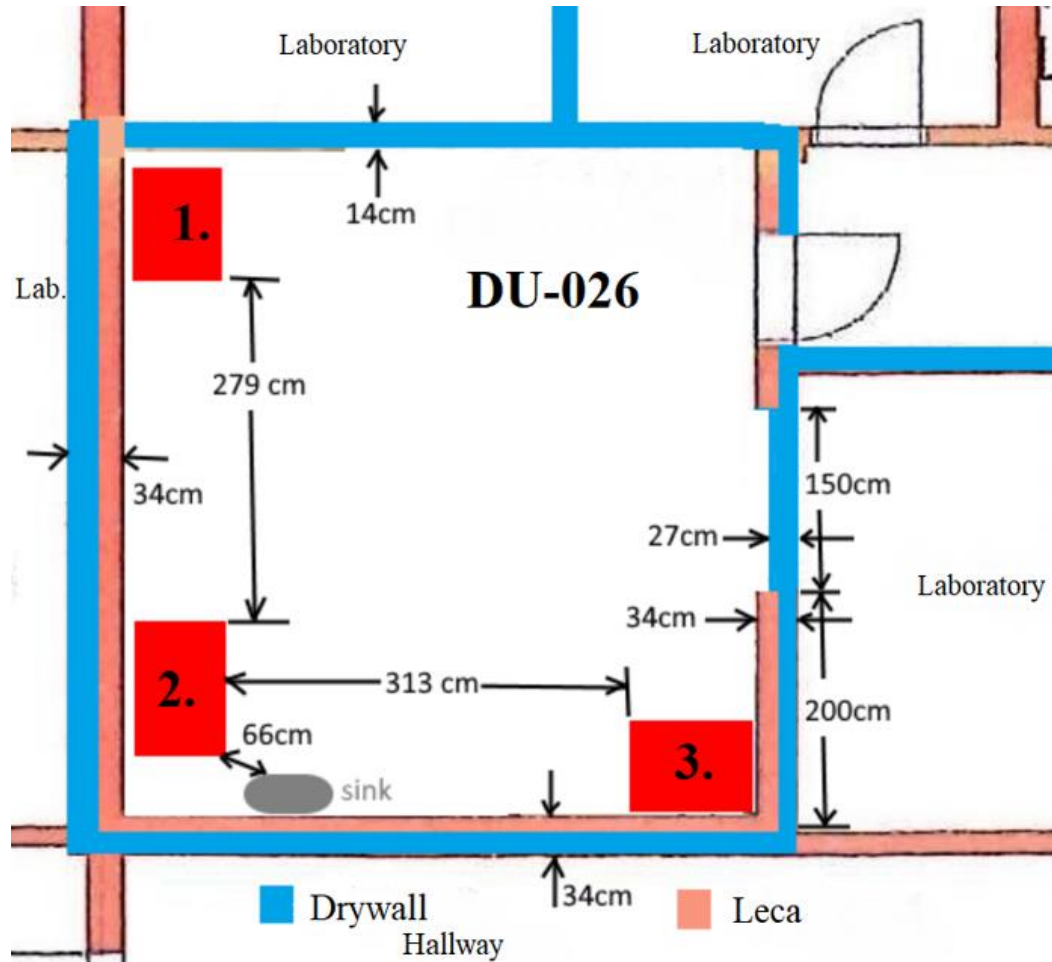
## 6.0 HISTORY OF EDITING

- 6.1 Written by Helene Tandberg and Frøydis Lie Kilmer: 14.02.2023
- 6.2 Translated from Norwegian to English by Deborah Ann Arnfinsen : 08.04.2023

## 7.0 REFERENCES

- 7.1 [Veileder 5 Røntgen-MR 2017.pdf \(dsa.no\)](#)
- 7.2 [ICON M2 Compact MRI system](#)
- 7.3 [Quantum Gx2 Micro CT](#)
- 7.4 [IconTM system](#)

Overall plan of DU-026



1. [Minispec Body Spec LF90II \(NMR\)](#)
2. ICON M2 Compact MRI System
3. Quantum GX2 micro CT

The figure shows the layout of the room with the position of the machines, the distance between the machines, the position of the sink and the thickness and material of the walls.

Likelihood		Description (this depends on what is being assessed, but these are examples):
1	Rare	< 1x pr 50 yrs. or rarer
2	Unlikely	< 1x per 10 yrs. or rarer
3	Likely	< 1x per yr. or rarer
4	Highly likely	1x per month or more often
5	Near certainty	Occurs weekly

DESCRIPTION OF CONSEQUENCE:

	Consequence:	Human:	Environment:	Equipment and economy:	Reputation:
1	Minimal	Injury that requires first aid	Minimal damage and short restitution	Activity stop < 1 day	Little influence on credibility and respect
2	Minor	Injury that requires medical treatment	Minor damage and short restitution	Activity stop < 1 week	Negative influence on credibility and respect
3	Major	Serious personal injury	Minor damage and long restitution	Activity stop < 1 month	Reduced credibility and respect
4	Serious	Serious personal injury, possible invalidity	Long term damage, long restitution	Activity stop ½ - 1 year.	Severely reduced credibility and respect
5	Catastrophic	Death	Extremely long, non-reversible damage	Activity stop: more than 1 year.	Permanently reduced credibility and respect

Probability	5	1*5	2*5	3*5	4*5	5*5
	4	1*4	2*4	3*4	4*4	5*4
	3	1*3	2*3	3*3	4*3	5*3
	2	1*2	2*2	3*2	4*2	5*2
	1	1*1	2*1	3*1	4*1	5*1
		1	2	3	4	5
Consequence						

Conclusion:

Colour		Description
Red	10-25	Unacceptable risk. Actions must be performed to reduce risk.
Yellow	4-9	Assessment area. The need for further actions to reduce risks should be assessed.
Green	1-4	Acceptable risk. Actions can be taken.

## Approval form for the use of room DU-026

I confirm that I have read SOP 18-02 "Use of the DU-026 and CT MR room" and understand my role and the regulations governing the use of the CT and/or the MR machine.

Date:

Role:

\_\_\_\_\_

Name

\_\_\_\_\_

Signature

Approved by:

\_\_\_\_\_

(PMSK / KPM section manager)