PROCEDURE V5 MARCH 2025

COLLECTION, STORAGE AND HANDOVER OF RADIOACTIVE WASTE

INTRODUCTION

Collection, storage and handover of radioactive substances is bound by legal requirements, that are established in, amongst others, the 'Nuclear Energy Act' (Dutch: '*Kernenergiewet*' or *KeW*) and the 'Radiation Protection Act' (Dutch: '*Besluit basisveiligheidsnormen stralingsbescherming*' or *Bbs*), and in the complex license that has been granted to the institutions on the Randwyck campus.

This procedure elaborates on the policy concerning the radioactive waste produced within the institutions participating in the complex license, and based on the agreements that all institutions have entered into concerning radioactive waste. Furthermore, it describes the tasks and responsibilities of the employees involved.

GOAL

Formalisation of the mode of operation concerning collecting, storing and handover of radioactive waste for all partners in the Complex License Randwyck.

DEFINITION OF RADIOACTIVE WASTE / LEGAL CONTEXT

Radioactive waste is defined as a radioactive substance for which no other use or recycling of either the product or the material is planned, and which will also not be discharged into water or air (*Bbs, article 10.7*).

A waste product does not fit the criteria of radioactive waste if

1. the concentration of the radioactive substance is lower than the appointed release value[1].

Radioactive waste must be removed as fast as reasonably achievable, unless the waste consists of nuclides that have a half-life of less than 100 days. In that case, they may be stored for a maximum period of 2 years for physical decay, in a facility suitable for this purpose.

Lastly, it is strictly prohibited to mix or dilute radioactive waste with the goal of lowering the concentration to a point below the legal release value.

STORAGE AND MANAGEMENT OF RADIOACTIVE WASTE WITHIN THE COMPLEX LICENSE RANDWYCK: CONDITIONS AND EXECUTION

Radioactive waste is produced within various departments of the institutions that participate in the complex license. The majority is generated as a by-product of procedures with radioactive sources in dispersible form that are used within the scope of medical diagnostics. In addition, there is also waste in the shape of sealed sources or activated materials.

To ensure a controlled environment and adequate management of waste, the Randwyck campus has been equipped with one central facility.

The central facility for radioactive waste is situated in the basement of the building Universiteitssingel 50 of Maastricht University (UM), with the Faculty of Health, Medicine and Life Sciences (FHML). The department of Radionuclide Laboratories (RNL) manages this facility. The facility has been equipped in compliance with legal requirements. The RNL department has appointed an employee who handles waste products with specific risks, who takes care of the collection, transportation and correct storage of radioactive waste, under the supervision

[1] Besluit basisveiligheidsnormen stralingsbescherming (Bbs), Addendum 3, part B and Regeling basisveiligheidsnormen stralingsbescherming (Rbs), Addendum 3.2 (Dutch only)

of the Radiation Protection Officer (RPO; Dutch: 'Toezichthoudend Medewerker Stralingsbescherming' or TMS) of the RNL department.

However, in specific situations it may be necessary to provide a facility for temporary storage near the work area where the waste is generated. In this facility, the waste can be stored while awaiting transportation to the central facility. Waste must be removed from the working area within 24 hours, and may be stored up to one week for temporary storage in the dedicated facility at the department, provided with the correct warning signs. In some situations, it may be desirable to store waste longer than 24 hours in the working area. This is possible, but always after consultation with the RPO of the department involved and always as short as reasonably possible.

Rooms dedicated to the storage of radioactive waste must meet the requirements that have been established for storage rooms. These are as follows[2]:

1. the equivalent dose rate on the outside must be as low as reasonably achievable, but may not exceed the value of 1 µSv/h at any point situated at 0.1 m of the surface;
2. the outside must be labelled with the hazard symbol for ionising radiation, as well as with the text: radioactive substances'[3],
3. the room must be soundly locked and may only be opened by persons that are authorised to do so by the employer;
4. the construction of the room must be such, that the resistance against fire is not lower than 60 minutes;
5. the responsible fire department must be noticed of the presence of the storage room (communicated via the Radiation Protection Unit);
6. in case of an easily portable storage facility must this be situated in a room or cabinet that can be securely locked and that can only be opened by persons who are authorised to do so by the employer;
7. the storage room must be equipped in such way that it can easily be cleaned / decontaminated, and be ventilated at a rate of at least three times per hour;
8. liquids may only be stored in durable containers with an adequate arrangement for collecting any leakages in place.

The central waste facility offers ample space for storing radioactive waste for the purpose of physical decay, up to a period of 2 years at maximum. It is also equipped with suitable measuring devices to ensure a correct disposal of waste that is demonstrably no longer radioactive.

The waste to be stored is digitally registered in categories of nature, amount, activity and place of origin of the waste.

Permission for manipulations with radioactive waste must have been granted in the form of a written internal permit (Dutch: 'schriftelijke interne toestemming' or SIT). This implies that the exposure of employees involved has been evaluated and analysed preceding the work, and possible measures have been taken prior to exposure.

SEPARATING RADIOACTIVE WASTE

Careful separation of radioactive waste on the spot where it is created, adds to a safe way of handling different waste categories, and at the same time prevents unnecessary discharge into the environment. This does justice to the ALARA-principle.

Separation of waste is based on two factors:

1. The radioactive component (the nuclide);
2. The nature of the waste product (physical state, chemical characteristics).

The primary goal of categorising waste into nuclides, is to separate the components that will decay completely within the maximum allowed storage time of two years, from those that will not. This ensures, that no unnecessary costs arise when the waste is being discharged to the certified institution for waste (COVRA) and also ensures that large volumes are being stored for years without a need to do so.

[2] For the full text, see complex license chapter 4, paragraph IV

[3] Also see procedure 'Zoning and warning signs of areas where sources of ionising radiation are handled'

Categorisation into nature of waste ensures compliance with the Environmental Law (Dutch: '*Wet Milieubeheer*'), by abiding by the rules for specific categories of waste (such as chemicals, pharmaceuticals, biological agents and specific hospital waste).

Execution: separating waste based on nuclide and nature

When separating radioactive waste, differentiating between nuclides is to be preferred. In some cases, practical matters make this impossible. In that case, nuclides with similar half-lives and physical characteristics are combined. This results in the following categories[4]:

a. short-lived waste: waste contaminated with nuclides with half-lives up to 6 days;
b. middle long-lived waste: waste contaminated with nuclides that have half-lives which exceed 6 days, but stay below 100 days;
c. long-lived waste: waste contaminated with nuclides that have half-lives which exceed 100 days.

Categories a and b are stored for physical decay, during at least 10 half-lives, after which the waste is checked for residual contamination before it is being disposed of. The department of Radionuclides Laboratories (RNL), in compliance with the protocol that was drafted for this purpose, performs this check for residual contamination.

Category c waste is waste that must be considered as radioactive waste when the amount of radioactive compound(s) exceeds the exemption levels, and therefore must be handed over to COVRA, the authorised organisation for radioactive waste in the Netherlands. In case the radioactive compounds stay below exemption levels, the waste will be considered as non-radioactive and will be disposed of as such, for economic reasons.

Waste of either category a or b is expressly not disposed of based on exemption levels. The reason for this is that waste, even with concentrations below these levels, may still be a source of spreading of radioactive compounds or the cause of contamination. Storing these categories within the allowed period honours the ALARA-principle and limits the disposal of radioactive compounds into the environment. An additional practical point is that this waste may give rise to dose rates above background levels, which will lead to problems when the waste is checked for contamination at the site of the waste processing company.

For all categories listed above (a through c) is the additional requirement, that they are separated into further categories, depending on the nature of the waste:

- Solid waste;
- Liquid waste (either organic or inorganic);
- Specific hospital waste;
- Waste contaminated with genetically modified organisms;
- Waste of animal corpses;
- Sealed sources;
- Activated parts or devices;
- Etc.

Separating waste of different nature prevents unwanted chemical reactions from occurring, and ensures processing of waste in compliance with legal requirements.

It is to be preferred that sealed sources, which are no longer used, are returned to their supplier. If this is not possible, they must be handed over to COVRA.

In the case of activated parts, one should determine the nature and activity of the nuclides with which they are contaminated as accurately as possible. This is the responsibility of the TMS of the department that owns the parts; the TMS should seek consultation with the TMS of the RNL department for this matter.

[4] *Departments may set subcategories based on other criteria. If they wish to deviate from this generic categorization, they will have to do so in consultation with the radiation protection expert of Maastricht University and record this in writing.*

HANDOVER AND TRANSPORTATION OF RADIOACTIVE WASTE

Radioactive waste that is handed over to the officer for harmful waste, for transportation to and storage in the central waste facility, must be packaged with care. In addition, one should keep account of the waste that is generated and handed over.

Below, the requirements for packaging and registration are described.

Registration

Data on the waste that is to be handed over must be registered on the form 'Internal transport of radioactive substances – appendix C'.

The form must contain information on:

- The origin of the waste,
- The nature of the waste,
- The nuclides present in the waste;
- (An estimation of) the order of activity. When the occasion arises, one can also be asked to perform a dose rate measurement on the surface of the package.

These data are registered by the RNL department, at the time of arrival at the waste facility.

Packaging

Waste must be packaged and transported in proper packaging. This implies that the package must be firmly closed, to prevent any spreading of radioactive substances. The package must be free of contamination on the outside. The sender is responsible for checking these points.

The packaging material must be resistant to its contents and meet the requirements for specific waste categories. When choosing packaging materials, one should be in keeping with the general procedures for waste packaging that are valid in the institutions whenever possible. This implies that the packages or containers which are used for radioactive waste, may be the same packages that are used for non-radioactive waste, for instance needle containers and containers for waste contaminated with biological agents or blood products.

The packaging must be labelled as waste contaminated with radioactive substances, by means of a label that depicts the warning signal for radioactive substances and the subtext 'radioactive substances'.

Handover

All radioactive waste must, after a potential temporary storage at the department of origin (up to a maximum of 1 week), be handed over to the employee handling harmful waste, to be transported to and stored in the central waste facility. From there, the final destination of the waste is determined.

Waste must be handed over in person by an employee of the department of origin, where a fully completed form (also see registration') must accompany every container that has been labelled as radioactive. Under no circumstances may this waste be left without supervision outside of a designated storage room.

Transport

Transportation of radioactive waste must be carried out as described in the procedure '*Internal transportation of radioactive substances*', using the form '*Handover of radioactive waste' (appendix C).*

STORAGE IN THE CENTRAL WASTE FACILITY AND DISPOSAL OF WASTE

Storage in the central waste facility

After arrival at the central waste facility, the handover forms are handed over to the TMS of the RNL department, who will register the radioactive waste in the designated system

Containers with waste are stored in designated rooms in the waste facility, separated into nature and nuclide. All waste that falls into categories a and b (half-lives up to 60 days), is initially stored for physical decay, during a period of 10 half-lives of the nuclide at hand.

After this period, a count rate is determined of the surface of the waste container. In case the result does not exceed a value that equals 1.5 times the natural background value, it is disposed of as non-radioactive waste, and handed over to an authorised waste processing facility. In case the measured count rate does exceed the set limit, the TMS will then try to find out if an explanation can be found for the elevated dose rates; possibly the waste may hold radioactive impurities with deviant half-lives. In any case, another period of storage will follow, up to a maximum total storage time of 2 years, after which another measurement will be performed. If this measurement still results in measurable radiation levels, the waste will be considered radioactive and treated as such for disposal to COVRA.

Regarding c-category waste, the amount of radioactive compound present is the determining factor for how the waste is disposed of. Liquid waste is sampled to determine a precise amount of activity (or activity concentration) in the waste. Solid waste is subject to a founded estimation regarding the amount of radioactive substances present. If the activity or activity concentration of the radioactive compound is smaller or equal to the legal limits for release as non-radioactive substances[1], and provided a count rate measurement will not show levels above 1.5 times the natural background, the waste is treated as non-radioactive and will be disposed of as such. In case the legal limits for release are exceeded, the waste will always be treated as radioactive and handed over to COVRA as soon as reasonably possible (but always within a period of 2 years).

RESPONSIBILITIES OF EMPLOYEES INVOLVED

Several employees are involved in the collection, handover and storage of radioactive waste. Their responsibilities are defined as follows.

Licensee

The licensee is responsible for providing and organising adequate facilities for collection, transportation and storage of waste in compliance with legal requirements.

Radiation Protection Unit

The Radiation Protection Unit (RPU; Dutch: 'Stralingsbeschermingseenheid') gives direction to the policy concerning treatment of radioactive waste within the complex license, and ensures it is formalised by the boards of the licensees involved. The Radiation Protection Unit oversees compliance with this policy and reports to the respective boards/licensees about this matter.

Radiation Protection Officer

The RPO sees to it that:

- Waste is separated and collected correctly, as described in this procedure, at the same time following the general waste management policy of the institution the TMS is employed at;
- Employees in his or her department are instructed regarding the regular procedure for radioactive waste;
- The administrative work of the waste that is produced within his or her department is done;

- That the handover of radioactive waste is carried out in compliance with the requirements as stated in this procedure.

Whenever necessary, but also periodically doing random sample surveys, the TMS carries out activity measurements of the waste. Also, (s)he may advise about any necessary additional measures that need to be taken for transportation of radioactive waste.

Radiation Protection Officer RNL

The RPO of the RNL department is additionally responsible for the management and storage of the radioactive waste in the central waste facility in compliance with the regulations as stated in this procedure.

The RPO RNL sees to it that:

- A risk analysis has been drawn of the work related to the collection, transportation and storage of radioactive waste, Also the RPO RNL advises with regards to the optimisation of this process;
- The areas, facilities and equipment in the central waste facility meet the legal requirements;
- Necessary equipment and means for ensuring a correct handling and storage of radioactive waste are present and available;
- Deviations and/or shortcomings are either reported to the Radiation Protection Expert (RPE) of UM or to the Radiation Protection Unit;
- Local procedures for correct handling, storage and disposal of waste, are present;
- The employee responsible for transportation and handling of waste is sufficiently instructed to do so;
- This employee, if necessary (based on a risk analysis), is given a dose meter to monitor personal exposure as well as any necessary additional means;
- The execution of tasks related to radioactive waste follows the statements as formalised in the whole of relevant procedures for this subject;
- The administrative task involved in the storage of waste, for the purpose of keeping the nuclear law files up to date and complete, is carried out, and reports about this subject to the RPE as well as the Radiation Protection Unit in case there is cause to do so, but always for the purpose of providing data for the annual radiation protection report;
- A correct procedure is followed for releasing non-radioactive waste and handed over to the waste-processing facility;
- Radioactive waste is handed over to COVRA within the set time limits. To do so, the RPO RNL handles the administrative process to offer the waste to COVRA, ensures that the packaging meets COVRA standards, and hands it over to COVRA.
- An accurate file of all waste categories present in the central waste facility (more specifically: waste that is in storage awaiting handover to COVRA and waste that is in storage for physical decay) is available at all times.

Employee responsible for handling and transportation of radioactive waste

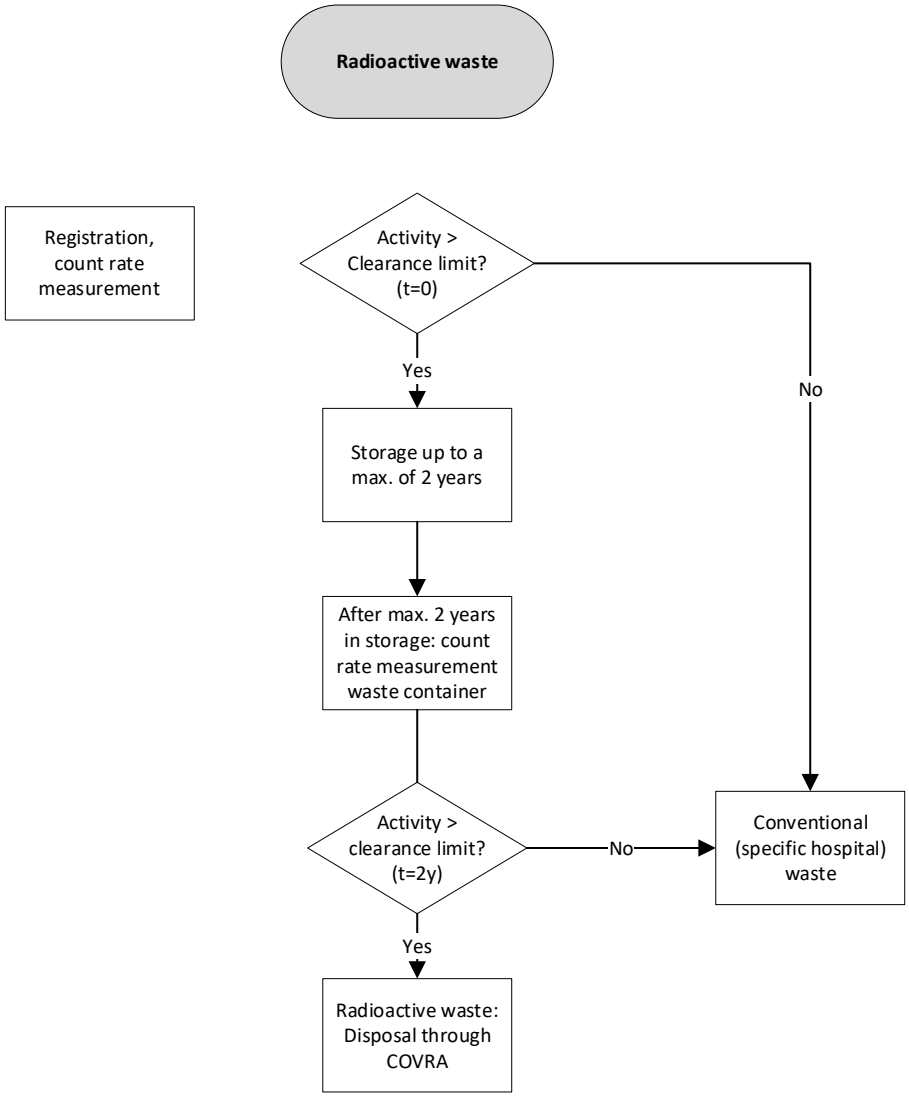
The employee responsible for handling and transportation of radioactive waste:

- Receives radioactive waste;
- Transports radioactive waste to the central waste facility of the RNL department in compliance with the requirements as stated in this procedure;
- Reports any contraventions to the regular mode of operation, deviations and incidents, instantly to the RPO of the department handing over the waste or to the TMS-RNL;
- Stores the waste in the central waste facility in the correct way, in compliance with the procedure drawn up for this purpose;
- Provides the RPO RNL with the handover forms of radioactive waste, for further administrative processing;
- Supports the RPO RNL when performing measurements of radioactive waste and when preparing the waste for handover to waste-processing facilities.

SUMMARY

The mode of operation concerning collecting, handover and storage of waste is summarised in *Figure 1* below:

Figure 1: Summarised mode of operation concerning collecting, handover and storage of waste



LIST OF ABBREVIATIONS

Dutch		English	
ALARA	As low as reasonably achievable	ALARA	As low as reasonably achievable
Bbs	Besluit basisveiligheidsnormen stralingsbescherming	-	-
CD	Coördinerend deskundige	-	Coordinating expert
COVRA	Centrale Organisatie voor Radioactief Afval	-	Central Organization for Radioactive Waste
FHML	Faculty of Health, Medicine and Life Sciences	FHML	Faculty of Health, Medicine and Life Sciences
KEW	Kernenergiewet	-	Nuclear Energy Law
Rbs	Regeling basisveiligheidsnormen stralingsbescherming	-	-
RNL	Radionuclidenlaboratoria	-	Radionuclide laboratories
SBD	Stralingsbeschermingsdeskundige	RPE	Radiation Protection Expert
SIT	Schriftelijke interne toestemming	-	Written internal permit
TMS	Toezichthoudend medewerker stralingsbescherming	RPO	Radiation protection officer
UM	Universiteit Maastricht	-	Maastricht University

REFERENCES

- Besluit basisveiligheidsnormen stralingsbescherming: https://wetten.overheid.nl/BWBR0040179/2021-07-01
- Regeling basisveiligheidsnormen stralingsbescherming: https://wetten.overheid.nl/BWBR0040509/2022-08-24
- Complex license Randwyck, ref. 2017/0511-12 (and subsequent changes)
- Form 'Handover of radioactive waste'
- Procedure 'Internal transportation of radioactive substances'
    - Form 'Handover of radioactive waste' (Appendix C)
- Procedure 'Zoning and warning signs of areas where sources of ionizing radiation are handled'
- Environmental law

Revision table	
Version 1 – April 2017	Initial version
Version 2 – October 2018	Change of Bs to Bbs
Version 3 – August 2020	New layout. No changes
Version 4 – June 2023	Changed flow chart; change in storage time in the working area and temporary storage. Changes to paragraph 'Packaging'.
Version 5 – March 2025	Boundaries category classification adapted to limit values in use in Beeldvorming2