Radiation Safety Handbook

Radiation Protection Unit, University of Groningen

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1. Introduction

This is the Radiation Safety Handbook created by the Radiation Protection Unit (SBE) from the University of Groningen (RUG). In this handbook, the structure of and methods used by the Radiation Safety Organization within the RUG are described. In addition, this handbook serves as both a policy document and directive for working with applications involving ionizing radiation within the organization.

Structure
The Radiation Safety Handbook is divided into two parts. Part I consists of both a detailed explanation of the organization as well as a guideline for the workings of the SBE. Part II gives an overview of the procedures and forms that are used by the SBE.

Part I: Chapter 2 deals with the principles of the radiation safety policy of the RUG. Chapter 3 gives a short introduction to the University organization and a global insight into the locations where ionizing radiation is used. In addition, a profile of the radiation safety organization and forums for consultation are given. Furthermore, all the officials and the tasks of the SBE are described. The following chapters present the various topics below:

Chapter 4 - Written Internal Permit
Chapter 5 - Purchase, Transport and Transfer
Chapter 6 - Use of Radioactive Materials, Sources and Ionizing Radiation-emitting Devices
Chapter 7 - Overview of Radiation Safety Regulations
Chapter 8 - Arrangement of Radiological Areas
Chapter 9 - Personal Control Devices
Chapter 10 – Control and Enforcement
Chapter 11 – Radiation Incidents and Disasters

The regulations for the user are given in Part II of this Handbook.

Whenever the “faculty board” is mentioned in the Radiation Safety Handbook, this refers to the director of Sector R&D of the UMCG, unless expressly stated otherwise.

Responsibility
Part I of this Handbook consists of the updated versions of Chapters 1, 4, and 5 from the request for the original Complex Permit from 1997. This update has had no impact on the basic principles of the radiation protection policy. However, in relation to the application for the Complex Permit, the description of the organization has been limited to the (relevant) minimum information and the justification for the use of ionizing radiation under the former Radiation Protection Decree has been supplemented. The importance of thorough risk analysis has been made more explicit. Chapters 4 – 11 have been added to increase the ease of usage of the Handbook for Radiation Protection Officers and those who request an Internal Permit. The Radiation Safety Instructions RUG, which was introduced in the previous Complex Permit, has been integrated into Part II of this new Handbook.
Part II of the handbook has been adapted due to a requested change of the complex permit in 2019. Especially the part on fission products has been changed. Finally, new laws and regulations have also been incorporated into this updated Handbook and the handbook is adapted to a permit alteration regarding the site boundaries.

H.F. Boersma, General Radiation Protection Expert
Updated June 2026

2. Principles of Radiation Protection

The radiation safety policy of the RUG is focused on controlling and, as much as possible, minimizing the radiation exposure of humans and the environment as a consequence of the use of radioactive materials, sources and ionizing radiation-emitting devices, both within and outside of the university grounds. The health and safety of all employees, students and guests of the university, and those of everyone in the vicinity of the university buildings, is of primary importance. Special attention is paid to the occupational health of exposed workers. The RUG wants to ensure that these workers handle radiation responsibly and without running unacceptable risks.

The legal framework for the policy is formed by the Nuclear Energy Act and its related Acts and Regulations. The law binds the use of radioactive substances and ionizing radiation-emitting devices to having a valid license. In addition, exposed workers should be expertly trained and should be provided with instructions for the various applications. The important aspects to keep in mind include the justification of an application, the ALARA (optimization) principle, the dose limit for exposed workers and the general public, and the assessment levels for the emission of radioactive materials. In addition, a well-organized Radiation Protection Organization is necessary to obtain and keep a Complex Permit.

The research within the University of Groningen in which radioactive materials, radioactive sources or devices that emit ionizing radiation are used is quite diverse. The nature of the research varies from fundamental to applied research. In general, the standard methods and techniques used within the RUG are widespread and generally accepted. These methods are indispensable for modern day research.

At the RUG, scientific research is performed which results in numerous publications, often in prominent scientific journals. The research is internationally well-regarded and contributes to the image of the Netherlands as a country with high-quality research.

Radioactive materials are used in diverse locations with the RUG for a multiplicity of applications for scientific and medical research. For example, nuclides such as ^{32}P are used for labeling nucleic acids (DNA, RNA) and ^{35}S is used for labeling amino acids but also for PET-nuclides like C-11 and F-18. In a number of cases, radioactive materials are injected into laboratory animals. Therefore, the RUG has obtained a permit in accordance with the laws for experimenting with animals. Following this law, there is an animal Welfare Body and an ethical review committee. The radiation exposure for the environment is hereby kept to a minimum. Alternative procedures are often not available.

Radioactive sources are used, for example, as calibrations sources and for the purposes of gas chromatography. In addition, radioactive sources are used for educational purposes and irradiation of tissue material and cells.

X-ray devices are not only used for scientific research but also have been used for diagnostic purposes (such as dentistry). The use of X-ray diffraction apparatus for performing structural analysis occurs mostly in physics and chemistry. In addition to these devices, electron microscopes are located in diverse locations within the RUG and are available for use in structural studies.

The alternatives for both the above mentioned accelerator and the “standard applications”, if they exist, are often too expensive, too insensitive or inaccurate, or involve a higher risk than the use of radioactivity. Often, the radiation exposure for people and the environment is negligible such as with the use of an electron microscope. A special place is occupied by research on the effects of radioactivity on humans and the environment, which uses per definition ionizing radiation and radioactive materials. The knowledge obtained can, for example, lead to better storage of radioactive waste, new treatments of tumors or better medicines.

In addition to the research function, the university also has a function as an educational institute. Thousands of students and many assistants and researchers in training (AIO’s and OIO’s) are educated.

The introduction to radioactive materials, sources and ionizing radiation-emitting devices forms a part of a number of study programs. Besides imparting basic knowledge of radioactivity such as decay curves, the inverse square laws, and protection devices, this introduction also serves as an introduction to research using radioactive materials, sources and devices. As a part of the introduction, the course student will be taught how to safely and responsibly treat radioactive materials or ionizing radiation-emitting apparatus. Where possible, the use of alternatives will be encouraged. The RUG is accredited to teach radiation protection courses for Radiation Protection Officers (RPO) Dispersable Radioactive Material (DRM) level D and C and Measurement and Control Applications Sources (MR-B), Measurement and Control Applications Devices (MR-T), Medical Applications (MA) and Radiation Protection Expert (RPE), as well as the basic course for radiation experts for dentists and orthodontists. These courses are also open for participation by third parties.

2.1 Justification

Within the RUG, the use of radioactive materials, sources and ionizing radiation-emitting devices is tied to having an Internal Permit. Every researcher who wants to use radioactive materials, sources or ionizing radiation-emitting devices must give a justification for their use as a part of the request for an Internal Permit. The justification must show that the benefits of use outweigh the risks for humans and the environment. Alternative procedures, if any, should be taken into consideration. Economic arguments may be a reason not to choose an alternative. During periodic controls of granted Internal Permits, the justification will be tested to see if it is still valid. New developments in alternative techniques may, over time, lead to the withdrawal of the Internal Permit.

Proceedings and/or working with applications that are present or could be present within the RUG thus have a broadly-stated place for the purpose of scientific research and education. Formally, these can be justified on the grounds of Article 2.2 of the Decree on Basic Safety Standards for Radiation Protection (Bbs), with reference to the Ordinance on Safety Standards for Radiation Protection (Vbs) , Appendix 2.1, under:

- a. Sealed source: I.A.1 (measure and control techniques), I.A.2 (calibration), I.A.3 (analysis), I.A.4 (non-destructive research), I.A.6 (product operation), I.A.8 (exploratory research), I.A.9 (consumer products);
- b. open sources: I.B.3 (research and experiments), I.B.4 (tracer measurements), I.B.5 (production of research resources), I.B.7 (cleaning or decontamination);
- c. devices: I.C.1 (analysis and research by means of X-radiation), I.C.2 (screening of objects using X-radiation), I.C.4 (research using Accelerators), I.C.6 (production of radio nuclides using Accelerators), I.C.7 (Measuring and Control applications);
- d. Applications using sealed sources, open sources and devices: I.D.1 (research), I.D.2 (demonstrations), I.D.3 (practice), I.D.7 (scientific) research and experiments;
- e. medical practice with devices: II.A.2 (examination of people on medical grounds);
- f. veterinary practice with devices and open or sealed sources: II.B.1 (diagnostics with devices and open or sealed sources), II.B.2 (radiotherapy with devices or nuclear medicine).

2.2 Optimization

The RUG strives to keep the radiation dose received by employees, students and members of the general public as low as can be reasonably realized on the basis of social and economic considerations. The radiation exposure outside of the organization as a result of air emissions, discharges to the sewers, and direct radiation are kept also as low as reasonably achievable, taking into account medical, occupational, social and economic factors. If possible, the radiation exposure outside the organization is kept under the Secondary Assessment Level. If this is not possible, then a motivated ALARA assessment is required for the respective application. During periodic controls, the implementation of the ALARA-principle will be re-evaluated. The measures taken or set in the context of optimization will be derived from a thorough inventory and analysis of the risks.

2.3 Dose limits

The legally-defined dose limits or dose restrictions are employed as the maximal limits for exposure to radiation, as defined by the Decree on Basic Safety Standards Radiation Protection.

Dose limits or dose constrains

	Not exposed worker Member of the public Students or interns (dose limit)	Exposed worker B (dose contrain)	Exposed worker A (doselimit)
Effective Dose	1 mSv/y	6 mSv/y	20 mSv/y
Skin and extremities dose	50 mSv/y	150 mSv/y	500 mSv/y
Eye lens dose	15 mSv/y	15 mSv/y	20 mSv/y

3. Organization of the University of Groningen

The University of Groningen is a modern, classic university: classic, in a universal sense, with a very wide range of disciplines, and modern, with regards to research, education, organization and facilities. The RUG has approximately seven thousand employees. Roughly 35,000 students follow a "scientific" education program and about 1500 researchers work on their PhD thesis.

3.1 General organization

The Higher Education and Research Act (WHW) regulates the management structure of universities and the actual missions of education and research.

Via the web page, http://www.rug.nl/about-us/organization/administrative/, one can find almost the complete description of the management structure within the RUG and the tasks of the various governing bodies. In this section, only those bodies directly pertaining to radiation safety will be discussed.

Executive Board

The Executive Board (CvB) bears the responsibility for the strategic policy and the daily affairs of the University as a whole. Radiation protection forms a part of this whole. The CvB functions as a corporation.

Faculty Board

The faculty board has the general leadership of the faculty and is taxed with the implementation of management tasks with regards to radiation safety issues, in accordance with the declared policy of the CvB management mandate. Within the faculty board, there is a person who is responsible for these tasks. In addition to the faculty, the RUG Radiation Protection Organization recognizes sector R&D (Medical Sciences), which is equal to the above described faculties at the organizational level.

3.2 Radiation Protection Organization

The Radiation Protection Organization of the RUG was set up to achieve the radiation safety goal. Broadly speaking, the organization consists of four entities within the RUG grounds, under which the radiological applications are grouped. Each entity has a Radiation Commissioner who has a seat on the central committee: the Radiation Protection Unit (SBE). The SBE also has two additional members (Central Radiation Protection Experts) of the Groningen Academy for Radiation Protection (GARP) from the Health and Safety Department (AMD) and is chaired by the General Coordinating Radiation Protection Expert. An overview of the entities is given below:

Entity	**Building number(s)**
1. KVI / PARTREC Zernikelaan 25, 9747 AA, Groningen.	57xx
2. Physics and Chemistry Complex Nijenborgh 3, 4, 6, 9747 AG, Groningen.	51xx, 56xx
3. Medical Sciences and Pharmacy Antonius Deusinglaan 1, 9713 AV, Groningen	3xxx
4. Life Sciences, Linnaeusborg Nijenborgh 7, 9747 AK, Groningen	517x
Applications that can not be assigned to one of the above mentioned entities are accommodated under the category 'others' with contact address:	GARP/AMD RUG Visserstraat 49, 9712 CT, Groningen.



Figure 1. Map of Groningen with locations of the RUG indicated.

Radiation activities predominately occur within the Faculty of Science and Engineering Nijenborgh 3, 4, 6 and 7 (1), Antonius Deusinglaan 1 (2) and Zernikelaan 25 (3). The different organizational parts of these faculties are located throughout the city (see map, Figure 1).

The Department of Physics and Chemistry, and the Department of Life Sciences from the Faculty of Science and Engineering are housed in buildings on the southeastern portion of the Zernike campus.

The Department of Pharmacy from the Faculty of Science and Engineering is housed in a building complex together with Sector R&D, near the center of the city.

KVI/PARTREC is located on the northernmost part of the Zernike site and is named after the former Nuclear Physics Accelerator Institute. The building houses the AGOR cyclotron operated by UMCG-PARTREC (under the Sector R&D of the UMCG), and several research groups from the Faculty of Science and Engineering.

3.2.1 Organization chart

At the central level, administered by the GARP/AMD on behalf of the Executive Board, lies the supervisory function for applications within the limits of the Complex Permit. Three Radiation Experts have been appointed to fulfill this supervisory function. They are supported by four Radiation Commissioners, one in each of the four aforementioned entities in which the RUG is divided (KVI, Physics and Chemistry Complex, Medical Sciences and Pharmacy Complex and Life Sciences / Linnaeusborg (Figure 2). The Radiation Commissioners are responsible for organizing the monitoring of applications within their entity.

For each application, a radiation expert is designated who directly supervises the operations and applications. Within the organization, these supervisors are called the Radiation Protection Officers (see Figure 2).

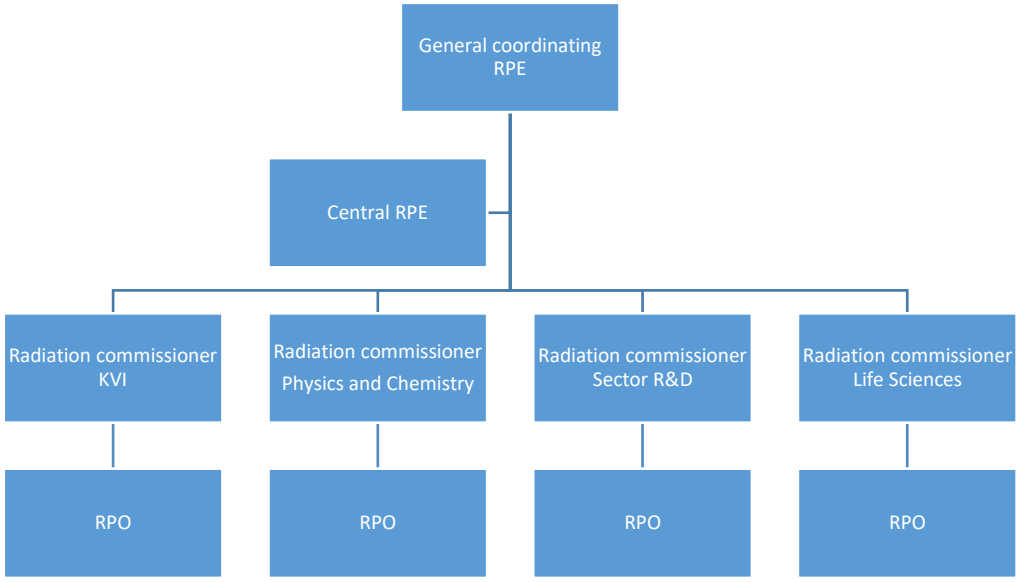


Figure 2. Organizational Chart of the Radiation Protection Organization from the RUG

The Radiation Commissioners fall under the Executive Board, both operationally and hierarchically, of the respective entity. There is a functional relationship with the General Coordinating Expert. The Radiation Commissioner is nominated by the Faculty Board of the respective entity (in consultation with the General Coordinating Expert) and appointed by the Executive Board.

The Radiation Expert within the entity is nominated by the Faculty Board in consultation with the Radiation Commissioner and likewise appointed by the Executive Board.

The responsibility for medical supervision and advice in this regard is given to the Radiation Physician.

Scope of the functions:

- General Coordinating Radiation Protection Expert 0,9 fte
- Other central and decentralized Radiation Protection Experts 1,5 fte
- Radiation Physician In coordination with the situation at all times

At each level in the organization (central, entity and local), there is a digital KEW file present.

3.2.2 Decision-making process

In principle, it is possible to discuss health, safety, and environment issues weekly with the responsible person on the Executive Board (the permit holder). If relevant subjects involving radiation safety are under discussion, the General Coordinating Expert can take part.

The functions of the SBE include serving as an expert consultant, preparing the radiation safety policy of the RUG, and making proposals to the CvB in this respect. In addition, they coordinate the (unit) implementation of the radiation policy and the oversight thereof. The SBE is chaired by the General Coordinating Radiation Protection Expert and meets once every 4-5 weeks.

Per entity, the Radiation Commissioners have structured consultation with the Radiation Protection Officers (Radiation Protection Officers), if necessary, to provide expert consultation and to coordinate (unit) implementation of the radiation policy within the entity and the control thereof.

The radiation physician can be included in the above-mentioned discussions as necessary on an ad-hoc basis.

3.2.3 Responsibilities and authority of the SBE

The SBE is the designated authority that oversees the central radiation protection responsibilities, provides consultation, makes agreements, and implements policy. However, the chairman of the SBE, the General Coordinating Expert, has the ultimate authority and responsibility, not the SBE itself. The tasks of the SBE are as follows:

a. Supporting the General Coordinating Expert as the representative of the permit holder (the Executive Board) towards the licensing and supervisory governmental authority.
b. Functioning as the coordinating body with regards to preparing and drafting the radiation safety policy and advising about this policy within the confines of the Complex Permit to the Executive Board and the faculties.
c. Supporting the General Coordinating Expert in organizing and exercising supervision, including conducting annual inspections at each location.
d. Assessing applications for Internal Permits to work with ionizing radiation, determining the conditions under which they are granted and, if necessary, supporting the General Coordinating Expert in the preparation of the advice on this matter to the Executive Board.
e. Providing information and arranging training in the field of radiation safety.
f. Preparing annual reports.

The SBE can hire an external radiation expert as an independent advisor whenever appropriate and/or necessary for the performance of specific tasks. The advisor should be in possession of sufficient qualifications to perform his or her tasks. The SBE may invite the advisor to join in on its meetings.

3.2.4 Responsibilities and authority of officials

In this section, the responsibilities and authority of the given officials are stated. The activities are listed in the comprehensive job descriptions for each official. These job descriptions are attached to this handbook as Appendix 1.

General Coordinating Expert

Responsible for

- The functioning of the Radiation Protection Unit within the limits set by the Decree on Basic Safety Standards Radiation Protection
- The granting of Internal Permits or advising thereon to the Executive Board
- The drafting of radiation safety policy
- The organizing and executing of supervision
- The updating of the Complex Permit for Nuclear Energy Act from the RUG and the maintenance of all contacts with licensing and inspecting bodies.

Authorized to

- Give a binding advice on behalf of the Executive Board to the Faculty Board or Director of a management unit regarding a matter relating to radiation safety in the Faculty or management unit
- Halt a proceeding on behalf of the Executive Board if this is judged necessary due to an unforeseen exposure to ionizing radiation that has occurred or threatens to occur
- Give authorization to resume a proceeding after a halt as described above has occurred with taking article 6.2 of the Decree on Basic Safety Standards Radiation Protection into account.

Central Radiation Expert
Authorized to

- Halt a proceeding on behalf of the Executive Board and, if possible, after discussion with the General Coordinating Expert, if this is judged necessary due to an unforeseen exposure or possible exposure to ionizing radiation that has occurred or threatens to occur

Radiation Commissioner (coordinating expert)
Responsible for

- The coordination of the implementation of the radiation safety policy and supervision within the respective entity

Authorized to

- Halt a proceeding in his/her entity on behalf of the Executive Board and, if possible, after discussion with the General Coordinating Expert, if this is judged necessary due to an unforeseen exposure to ionizing radiation that has occurred or threatens to occur

Radiation Protection Officers (Radiation Protection Officers, Radiation Protection Officers)
Responsible for

- The implementation of the radiation safety policy and supervision within his/her application

Authorized to

- Halt a proceeding in his/her application on behalf of the Executive Board and, if possible, after discussion with the General Coordinating Expert, if this is judged necessary due to an unforeseen exposure to ionizing radiation that has occurred or threatens to occur

Radiation Physician
Responsible for

- The implementation of medical supervision of A-employees as described in article 7.21 of the Decree on Basic Safety Standards Radiation Protection
- The implementation of a medical exam of workers if the dose limit has been exceeded or if appropriate in case of an accident or radiological emergency

Authorized to

- Give a binding advice to the Faculty Board or Director of a management unit on behalf of the Executive Board and, if possible, after discussion with the General Coordinating Expert, on the actions to be taken concerning the health of the worker examined

3.2.5 Internal Permits

The application for an Internal Permit should be done through the Faculty Board by the person who is directly responsible for and involved in the application, or by the Faculty Board itself when multiple management units are involved. The application can be submitted directly to the SBE. The Internal Permit is given to the Faculty Board or the director of the management unit in which the authorization applies. The Radiation Protection Officer named in the Internal Permit is nominated after consultation with the applicant(s), the Radiation Commissioner and the Faculty Board.

The following persons are involved in an application for an Internal Permit:

1. the applicant (the person who is directly responsible for and involved in the application),
2. the Faculty Board (person responsible for radiation safety) or the director of a management unit as the holder of an Internal Permit,
3. the Radiation Commissioner, as the supervisory person in the entity in which the application will occur,
4. the Radiation Protection Officer, as the supervisory person for the daily practices concerning the application.

All sign the application, and then the application is processed. The board of the faculty can mandate the radiation commissioner to sign on behalf of the board. The fourth person will be appointed by the Executive Board when granting the permission.

Figure 3 below gives an overview of the responsibilities with regard to the Internal Permit. The right side sketches the management and line organization. The Executive Board is the ultimate responsible party and under which the Faculty Board functions as the Internal Permit holder. The Faculty Board has the responsibility for the application with its management unit. The position of the Radiation Protection Officer is shown on the left side of the diagram. He/she functions as the supervisor for the applications or activities, and for the exposed workers that perform these actions, but he/she is not responsible for the application.

The various consultation forms are not reproduced in the diagram below (see Section 3.2.2 for an explanation). The black arrows in the diagram indicate how an authorization is requested and granted.

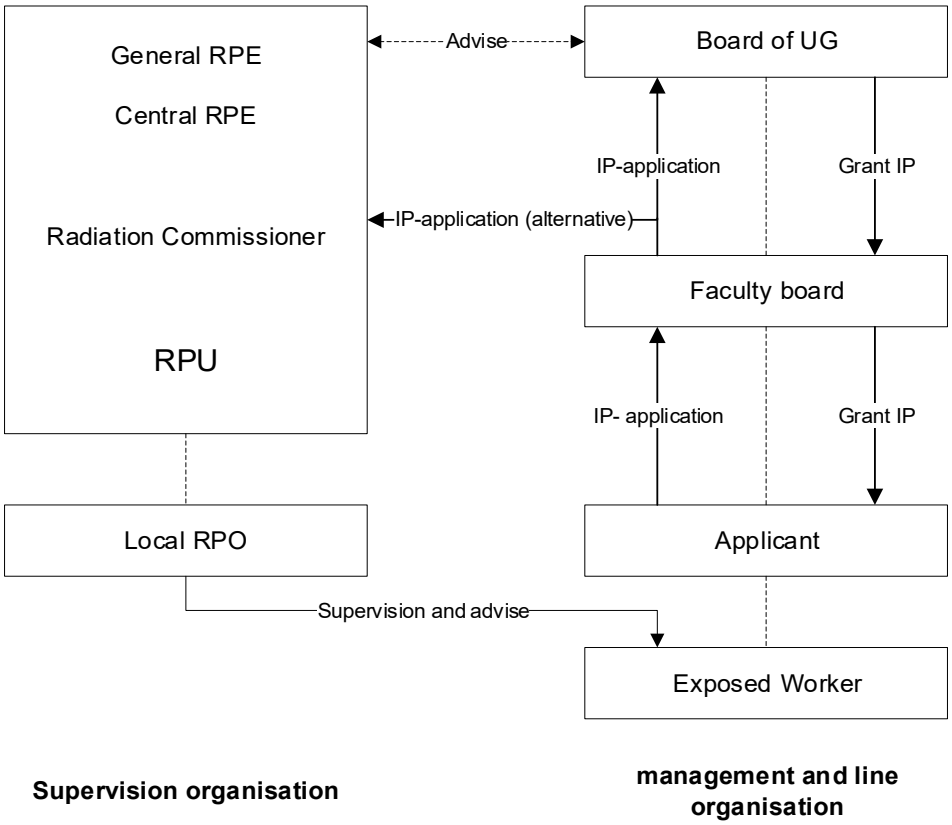


Figure 3. Overview of the responsibilities with regards to Internal Permits

Based on the Regulation on Basic Safety Standards Radiation Protection article 5.30 chapter b, the Executive Board has the ability to mandate the granting of the Internal Permit to the General Coordinating Expert. Because of clarity this option is not included in figure 3. The exact procedures concerning the granting, changing and withdrawing of an Internal Permit are recorded in the regulations and procedures in this Handbook (see Chapter 4). It also indicates in which cases an Internal Permit must be requested and when it can be accomplished with an (internal) Notification.

3.2.6 Occupationally-exposed people

Someone who is occupationally exposed, or who works regularly with radioactive materials or ionizing radiation-emitting device as a part of a study, and thereby could receive a radiation dose of more than 1 mSv per year, is considered to be an exposed worker. Depending on the application and the nature of the work, the exposed worker is classified as a Category A or B worker.

Exposed workers that occupationally could receive a radiation dose of more than 6 mSv per year are classified as Category A. Exposed workers that occupationally could receive a radiation dose of more than 1 mSv per year, but less than 6 mSv per year, are classified as Category B.

The Radiation Protection Officer, who oversees an application, and the Radiation Commissioner of the entity under which the application falls, decide in which category an exposed worker should be classified (if any) on the basis of a risk inventory. They can also consult with the Radiation Physician and a Central Expert, if necessary. In the procedure "Classification of exposed workers" (P02), the details of classification will be discussed. The Radiation Protection Officer keeps an overview of the exposed workers and their classification in the digital KEW File of the application. The Radiation Protection Officer can register an exposed worker at the dosimetry service of Mirion.

All Category A workers must undergo a medical exam before starting their work, which is performed by a company physician from the AMD under the responsibility of the Radiation Physician from the RUG. In addition, Category A workers must undergo a yearly medical exam by or under the responsibility of the Radiation Physician. Category B workers are covered by the regular occupation medical care.

For employees working at several institutions (usually UG and UMCG), where occupational exposure to ionizing radiation can occur at both institutions, the summed dose can have consequences for the (category) classification as exposed employee exposed. **P04** describes which procedure is followed if an employee is exposed at several institutions.

4. Written Internal Permits

Within the RUG, the use and possession of radioactive materials, sealed sources or ionizing radiation-emitting devices is in principle bound to the possession of an Internal Permit or Notification. The regulations and forms referred to in the text can be found in Part II of this Handbook.

Request for a written Internal Permit
An Internal Permit should be requested by means of the **Application Form: Request for Internal Permit (F01).**

The procedure **Processing the Internal Permit Form** (**P01)** describes how the application is processed. An application is not admissible if it has not been approved by the Radiation Commissioner from the appropriate entity.

The application form and accompanying appendices (if necessary) form the basis of the Local KEW File, which should be kept near each permitted application. It is the task of the Radiation Protection Officer to keep the Internal Permits current.

Formal change in a written Internal Permit
A change in an Internal Permit needs to be requested using the form **Change in Internal Permit (F02)**. This form should be completed for a proposed change or extension of the application for which an Internal Permit has been given, whenever the risks for the particular application change and an adjustment in the risk analysis occurs. In addition to the change form, the form **Application for an Internal Permit (F01)** should be completed again and include the changes in answers.

Extension of an Internal Permit that has been granted for a limited time can be accomplished through the use of the form **Extension of an Internal Permit (F06)**. This form should be submitted to the SBE well before the validity of the current Internal Permit expires. Processing of the forms is carried out according to the procedure **Processing of an Internal Permit (P01)**.

Administrative change in a written Internal Permit
An administrative change in an Internal Permit is possible in an expansion or reduction in the scope of the Internal Permit, which does not have any consequences for human exposure, emissions to the environment and the appropriate risk analysis for the specific Internal Permit (for example, changing of an apparatus with a similar device or adding a calibration source). With regard to the choice of a formal or administrative change, consult the General Coordinating Radiation Expert. For an administrative change, simply submit a revised annex to the written Internal Permit.

Terminating a written Internal Permit
If the application for which an Internal Permit has been given has ended, the form **Repeal of an Internal Permit (F03)** should be completed and submitted to the SBE no later than two years after termination. his form will be processed according to the procedure **Processing of an Internal Permit (P01).**

All conditions stated in the Internal Permit remain in effect until the Internal Permit has been repealed.

Processing and assessing an application for Internal Permit
The application for granting, repealing, changing or extending an Internal Permit should be addressed to the SBE of the RUG.
The SBE records the date received on the application and assigns a number to it. The application will not be admissible if the application is incomplete or unclear, or if it has not been approved by the

Radiation Commissioner of the appropriate entity. In this case, the applicant will be given the opportunity to correct these deficiencies.

Risk analysis and evaluation (RI&E)
An essential part of the application for granting (or changing) an Internal Permit is completing a risk analysis and evaluation (RI&E) for the use of radioactive materials or ionizing radiation-emitting devices. In such an RI&E, attention is focused on both regular, as well as potential, exposure to ionizing radiation for workers, members of the general public and the environment. On the basis of the outcome of the risk analysis, the conditions are determined for working with the specified materials or device. The RI&E also forms the basis for assessing the application by the SBE.

The RI&E is an explicit part of the Internal Permit, regulations described in the RI&E are binding.

The SBE assesses the application for granting an Internal Permit on the following points:
a. Is the request allowed within the Complex Permit of the RUG?
b. Is the use of radioactive materials or ionizing radiation-emitting devices justified in the application? Do alternatives exist and if so, why were these not chosen?
c. Do the locations where the applications will be performed fulfill the requirements of the applicable regulations? The relevancy of storage units will also be considered. Has the RI&E been performed such that an estimate of the application dose level for workers, the general public and the environment has been calculated (incl. question g) and are dose results of regular actions and foreseen unintended events have been taken into account? Have the outcomes of the analysis been properly evaluated according to the ALARA principle (see questions d through f and h)?
d. Do the work instructions and regulations, and any maintenance instructions offer sufficient guarantee for radiation safety in general and (radiation) safety of the workers in particular?
e. Are the prescribed safety measures and the emergency plan adequate?
f. Is it known who the exposed worker is or will be? Are the exposed workers classified in the correct categories?
g. Are the correct emissions to the environment reported?
h. Has sufficient substance been given to the ALARA-principle targeting the protection of workers and other people, the environment, and the limitation of waste?
i. Will any legally set dose limits be exceeded?
j. Will any specific regulations concerning highly active sources or the security of radioactive material be applicable by the issuance of the Internal Permit? If so, will all the requirements of these regulations be fulfilled?
k. Can the intended Radiation Protection Officer honor his/her obligations with regards to administration and oversight?

If the location where the application will take place is not explicitly given in the Complex Permit or the relevant application, the application will also be assessed on the following points:
l. Is it plausible that the application can not take place within the usual locations?
m. Will any Secondary Level limits[1] be exceeded?

The RI&E is drawn up in accordance with the questions posed in Appendix A. belonging to Article 2.1, paragraphs 1 and 2 of the Radiation Protection Occupational Exposure Regulation 2018:

1. Risk Identification.

a. Have all sources of ionizing radiation and their properties been inventoried?

b. What actions are performed with these resources? If necessary, the actions are split into partial actions in order to specify the different exposure risks.

—

[1] *see* ***IV12 Granting Internal Permit for using ionizing radiation at varying locations in the Netherlands*** *for more information.*

c. How many actions, and if applicable partial actions, are performed on an annual basis and how many and which employees can be exposed to this?

d. Where are the acts, and where applicable partial acts, performed?

e. Which exposure pathways are involved?

f. Which foreseen unintended events could contribute to the potential exposure of the workers? and

g. What technical and organizational measures have been taken to prevent or, if this is not reasonably possible, to limit the exposure of workers as much as possible?

2. Determination of exposure.

a. What is the regular exposure of the workers?

b. What is the potential exposure of the workers?

c. What is the probability of the occurrence of the foreseen unintended events.

d. What is the effect of personal protective equipment.

3. Risk Assessment.

Are the requirements laid down by or pursuant to the Decree with regard to:

a. the basic principles regarding justification and optimization;

b. the dose limits;

c. the dose restrictions;

d. the identification of exposed workers based on the determined regular and potential exposure;

e. the classification of exposed workers in category A or B based on the determined regular and potential exposure;

f. the identification and division of spaces in controlled area or supervised area; and

g. the need to update the measures taken.

If the location where the application will take place is not explicitly mentioned in the Complex License or the associated applications or if the location does not fall within the area of one of the four entities, the application will also be assessed on the following points:

- *Has it been made plausible that the application cannot take place within the usual locations?*
- *Is any Secondary Level exceeded?*

Notification
In the following cases, an application for an Internal Permit is not required and suffice a notification. A notification can be done using the **notification form (F05)**. Please note that the legal framework remains in force even in the case of a notification.

The following general applications are involved:

1. Devices having a rated voltage of not more than 30 kV which, under normal operating conditions, do not exceed an ambient dosage-equivalent rate of 1 μSv per hour, other than electron microscopes or X-ray diffraction, at a distance of 0,1 m from any accessible surface of the apparatus.

2. Radioactive material which, if considered separately at the involved location, would be exempted under the Decree on Basic Safety Standards for Radiation Protection, Section 3.3 or the Decree on Nuclear Installations, Fissile Materials and Ores.

In addition, for the following specific applications, for which the SBE has a generic RI&E available, a notification is also sufficient:

1. the possession and use of powders and solutions containing uranium for the purpose of electron microscopy or X-ray diffraction. A maximum of 16,6 kBq (1,3 grams) of natural or depleted uranium in 2% solution is permitted. For larger quantities an Internal Permit must be requested and the operations must be carried out within an isotope laboratory. The regulations mentioned in **SV18 Substances containing uranium in small quantities** applies.

2. The possession and use of a limited number of (old) utilitarian objects (such as dials containing radium or emergency signal containing tritium) and small quantities of natural uranium or thorium-containing stone/minerals, solely for demonstration purposes (exhibitions or education). The condition for this is that under normal circumstances the ambient doses equivalent rate at 0.1 m from any accessible outside of (the housing of) the object does not exceed 1 μSv per hour. The regulations mentioned in SV20 Utensils and stone/minerals applies.

3. The possessing and using sealed radioactive sources in liquid scintillation counters. For all activities involving sources from liquid scintillation counters, it is necessary to apply for an Internal Permit to the extent that these exceed the applicable exemption limit.

For each notification, the applicant must appoint a contact person who already works as the Radiation Protection Supervisor for a current Internal Permit or is a radiation commissioner for the concerning entity. If this is not available, an Internal Permit must still be applied for.

After drawing up a generic RI&E, the SBE may decide to settle for a notification for other applications as well if the risk to employees and the environment is negligible at all times.

If a notification appears to involve a higher risk than that taken into account in the RI&E, an Internal Permit is still required.

5. Purchase, Transport and Transfer

In order to make use of applications involving ionizing radiation, a logistics plan is necessary that encompasses the ordering, transport, transfer and waste disposal for these applications. Various legal frameworks prescribe provisions regarding the transport, transfer and disposal of radioactive materials, sources and devices. In addition, various policies apply with regard to the ordering and receiving of radioactive materials within the buildings of the RUG.

Purchasing and ordering
Radioactive materials and sources may only be ordered and received by, or under the responsibility of, the Radiation Protection Officer. Each order of a radioactive material or source must be initialed by the Radiation Protection Officer who has oversight on the radiological procedures, or his or her designated (in writing) replacement. Purchase order requests for radioactive materials and sources by others will be returned to the Radiation Protection Officer or, if it is unclear which Radiation Protection Officer should have been involved, to the Radiation Commissioner.

Placement of purchase orders can only occur after an Internal Permit has been granted and if the order falls within the scope of the Authorization. The current orders should be kept with the administration in the specific location.

If radioactive materials is purchased without the knowledge of the Radiation Protection Officer, this should be reported immediately either directly to the General Coordinating Expert or via the Radiation Commissioner.

Prior to purchasing an ionizing radiation emitting device or devices, the SBE has to be informed in order to prepare or changing an internal permit or notification. A device for which an internal permit is required may only be received after the internal permit has been granted.

Receiving
Packages containing radioactivity are only delivered at the designated locations. At these locations there is sufficient supervision and knowledge for the temporary storage of packages containing radioactivity. Entry will be reported to the RPO as soon as possible. Radioactive packages are received under written protocols. Only undamaged packages without surface contamination are accepted.

When leaving a radionuclide laboratory, returnable packaging must be free of radioactive contamination and warning signs for radioactive substances or sources.

Prior to the commissioning of an ionizing radiation emitting device, an acceptance test must be carried out by or under the responsibility of the Radiation Protection Expert. The SBE must be informed of any changes in the use or location of the device(s).

In IV06 the rules concerning the reception of radioactive substances and equipment emitting ionizing radiation are further elaborated.

Internal transport
During internal transport of radioactive material, applicable protection materials should be used. If radioactive materials are present in a dispersible form, these may only be transported using a “double containment” method (i.e.: container within another container). If a designated route should be taken for internal transport (to a certain department or storage place), then this should be defined in the instructions. This route should be designed to limit as much as possible the interaction between the transport and the flow of people within the building (for example, by using corridors in basements and service elevators).

External transport
Transport of radioactive materials is bound to the legal transport requirements which are stated in various regulations and decisions. Transport on the roads should be accomplished preferably by using an approved carrier. The transport service from the RUG is equipped to perform such shipments. The SBE provides the mandatory reporting of shipments by the transport service of the RUG through the use of an annual generic report.

For all other forms of transport, the General Coordinating Expert should be contacted in a timely manner.

Transfer
When a radioactive source will be transferred to a third party, it should be ensured that the source will be transported in the correct manner, that the receiving party has a permit for possession of the transferred application and a written declaration of transfer should be signed. This declaration should be placed in the local KEW file.

When transferring or discarding an ionizing radiation transmitting device or the devices, a written certificate of transfer must be signed. This document must be placed on RADMIN.

Should a source or device be transferred to a third party or to another department within the RUG, the Internal Permit almost always should be adjusted.

Disposal
The disposal of radioactive waste by designated companies should be centrally coordinated. If a source, contaminated waste, potentially contaminated waste or activated material must be disposed of, contact with the Radiation Commissioner or with one of the Central Radiation Experts should be sought.
When an appliance emitting ionizing radiation is discarded, dismantling or demolished, this must be documented. The RA stickers on the device must be removed. Please note: if contaminated or activated parts may be present in the equipment to be removed, the radiation commissioner or radiation expert must be contacted.

6. Use of Radioactive Materials, Radioactive Sources and Ionizing Radiation-emitting Devices

Radioactive sources are classified on the basis of capacity: radioactive materials in dispersible form, encapsulated and sealed sources, fissionable materials, ionizing radiation-emitting devices and Accelerators. Proceedings with radioactive materials are only performed after a written Internal Permit is granted to the Faculty Board by, or on advice of, the General Coordinating Radiation Expert. Conditions are bound to proceedings with radiation sources which are recorded in the written Internal Permit and in the radiation protection regulations. In addition to a number of general conditions, source-specific conditions may also be prescribed in the Internal Permit.

Radioactive materials in dispersible form (open source)
Proceedings with radioactive materials in dispersible form should, in principle, only be performed in radionuclide laboratories. Additional regulations apply to working with such materials. To work with fissionable materials and ores, special regulations apply.

Sealed radioactive sources (sealed source)
A sealed radioactive source is a source of ionizing radiation which is formed by radioactive materials that are imbedded in or permanently attached to a non-radioactive carrier material, or are surrounded or encapsulated in a housing of non-radioactive material. The carrier material or housing offers sufficient resistance to prevent any dispersion of the radioactive materials from the source, under normal circumstances.

A sealed source should be checked upon receipt and thereafter at least once per year for contamination by leakage. The leakage monitoring should be done by or under the responsibility of a skilled expert who has a diploma RPE. The procedures to be followed should be set in writing. Leakage tests do not have to be performed on sealed sources that have an activity of less than 1 MBq and a radiotoxicity of less than 0,02 Re_{inh}, or on gaseous sealed sources.

Sealed sources according to RUG specifications
A sealed source according to RUG specifications, called a sealed source from now on, is a source of ionizing radiation that is formed by radioactive materials imbedded in or permanently attached to non-radioactive carrier materials, or is surrounded or encapsulated in a housing of non-radioactive material. The carrier material or housing offers sufficient resistance to prevent any dispersion of the radioactive materials from the source under normal circumstances. The encapsulation of the source does not fulfill the requirements laid down in the ISO 2919/1980 norm or an equivalent standard because:
1. the source as a calibration or measuring source is produced in-house, or
2. the activity of the source is less than 1 MBq, or
3. the ISO 2919/1980 certificate is no longer available.

Sealed sources according to the RUG specifications are practically considered to be encapsulated radioactive sources with an ISO-classification C11111, for which set conditions also apply.

Security of radioactive substances
If the total activity in an area exceeds certain limits and certain categories of application (such as the high activity sources (HASS) to be dealt with below) are subject to specific requirements with regard to the security of these radioactive substances. In accordance with Article 4.2 of the Bbs, a security plan is then required. This is drawn up and maintained under the responsibility of the person responsible for security and in cooperation with the SBE. According to art. 6.7 of the Bbs and art. 6.2 of the Rbs, there is also an obligation to have a company emergency plan. The company emergency plan is drawn up and maintained by the SBE.

This aspect is taken into account when assessing the granting of a (change to a) Internal Consent. In practice at the RUG, this will only be relevant in the case of the use of high activity sources.

High activity sources
High activity sealed sources (HASS) are subject to additional requirements in addition to the general conditions for sealed radioactive sources. When purchasing HASS sources, an amount of money should be set aside to cover the costs of the future disposal of the high activity sealed source. This guarantee continues to apply until the high activity source has fallen below the activity limit for high activity sources (from Annex 4, Bbs) due to radioactive decay. Each high activity source has a unique identification number.

Internal Permits for high activity sources shall only be granted after a company emergency plan and a security plan have been realized and, where appropriate, implemented.

Fissionable materials and ores
Fissionable materials are used in electron microscopy and as calibration sources in radiation measuring devices. The use of fissionable materials carries limitations and conditions, just as for other radiation sources. When small quantities are used, often filing a Notification is sufficient as long as the stated conditions are observed.

Security of radioactive materials
Should the total activity in an area exceed a certain limit and for certain application categories, specific requirements apply with regards to the security of the radioactive materials. During the assessment of the application for an Internal Permit, this aspect is taken into account. Practically, within the RUG, this is only relevant if highly-active sources are used.

Devices
X-ray machines, X-ray diffraction devices and electron microscopes should only be operated by qualified people in areas that have been defined in the Internal Permit. After a change in room, the device should only be used after a written Change in an Internal Permit form has been filed and permission granted.

A device can only be purchased, installed and used after an Internal Permit is granted. Every device that has been substantially modified must be recertified in the areas of physical, technical, and radiation protection aspects before being operated.

The device and the associated security and shielding should be inspected for proper operation at least once per year by an expert.

Accelerators
An Accelerator is an apparatus with an accelerating voltage of 1 MV or more, or a device whose purpose is to accelerate particles to an energy level of 1 MeV or more.

Within the RUG complex license, the following pre-existing Accelerator is in use:

- the AGOR cyclotron at Zernikelaan 25 (KVI),

Before new Accelerators may be used, the Complex Permit for the RUG would need to be adjusted, which requires approximately a year to accomplish. Therefore, in this case, early contact with the General Coordinating Expert is strongly advised.

The request for modification of the Complex Permit must be accompanied by a termination plan for the relevant accelerator or cyclotron if particles can be accelerated to an energy of more than 20 MeV and 8 MeV respectively. The termination plan, which must also include a financial provision for future dismantling, is drawn up in consultation with the SBE.

Irradiation or treatment of laboratory animals with radionuclides
In all cases where laboratory animals are irradiated or treated with radionuclides, instructions for working with laboratory animals should be present which fulfill the requirements of the Law on Animal Experiments. In addition, specific instructions for working with ionizing radiation should be followed.

Before an experiment on animals can be assessed by the Radiation Protection Officer for radiation safety and radiation exposure aspects, permission should be obtained from the Central Commission on Animal Experiments for performing the experiment.

Laboratory animals that have been treated with radionuclides should be separated from non-treated animals to prevent dispersion of the radioactivity. The animal cages should be placed in an area that falls under the supervision of a radionuclide laboratory. If an animal cage is kept outside of a radionuclide laboratory, then only lab animals treated with radionuclides where the established residual activity falls below the threshold limits should be kept there.

Radiodiagnostic research on humans
The treatment of humans with radionuclides for research or therapy purposes is not allowed within the scope of the complex permit of the RUG. Should such a treatment be desired, the Complex License must be adjusted. This adjustment requires approximately one year to accomplish and therefore the General RPE should be contacted at a very early stage of the proposed project.

Radiodiagnostic research on humans is only permitted within the scope of the Complex Permit if the irradiation occurs as a necessary part of a dental examination. For radiodiagnostic research on humans for a purpose other than dental, the same regulations apply as for radiotherapeutic exposure of humans to ionizing radiation.

7. Radiation Protection Regulations

To achieve an optimal level of radiation protection, the Internal Permit refers to additional conditions that are stated in the radiation protection regulations. These regulations are subdivided into general and specific regulations. In addition to the regulations, directives and instructions are also used, which have been created by the SBE. This extra information is divided into procedures and internal regulations. Table 7.1 gives an overview of the subjects in the radiation protection regulations. New regulations may also be added in the future. At both the work station and department, radiation protection regulations may be supplemented with specific regulations imposed by the Radiation Protection Officer. The SBE also uses a number of standard forms.

Table 7.1: Overview of radiation protection regulations and relevant documents. For contents, see Part II of this Handbook. Forms are available separately.

Procedures

Code	*Description*
P 01	Processing and assessing applications for an Internal Permit
P 02	Classification of exposed workers
P 03	Internal Permit inspections
P 04	Exposed workers at multiple employers

Internal regulations

Code	*Description*
IV 01	Annual report SBE
IV 02	Changing documents that form a part of a Complex Permit
IV 03	Contents of the central KEW-file
IV 04	Contents of the entities KEW-file
IV 05	Radiation incidents
IV 06	Ordering and receiving radioactive materials and sources
IV 07	Cleaning activities in radionuclide laboratories
IV 08	Work and safety instructions for uranium-containing materials
IV 09	Use of gloves in radionuclide laboratories
IV 10	Centrifuging and vortexing
IV 11	Waste and discharge policies
IV 12	Granting an Internal Permit for the use of ionizing radiation at varying locations in the Netherlands
IV 13	Highly active sources and safeguarding radioactive materials
IV 14	Continuing education of Radiation Protection Officers
IV 15	Instructions Exposed Workers

Forms

Code	*Description*
F 01	Application form Request for an Internal Permit
F 02	Application form Change of an Internal Permit
F 03	Application form Withdrawal of an Internal Permit
F 04	Application form Extension of an Internal Permit
F 05	Notification Form
F 06	Inspection Report

General regulations

Code	*Description*
AV 01	Request for an Internal Permit
AV 02	Change or Extension of an Internal Permit

AV 03	Withdrawal of an Internal Permit
AV 04	Local Nuclear Energy Act (KEW) file
AV 05	Expertise and training requirements
AV 06	Category classification of exposed workers
AV 07	Personal control devices
AV 08	Missing, accidents and incidents
AV 09	Radiological areas
AV 10	Internal Permit inspections
AV 11	Notification
AV 12	Radiation monitors
AV 13	Replacement of the Radiation Protection Officer

Specific regulations

Code	*Description*
SV 01	Purchase of radioactive materials and sources
SV 02	Storage of radioactive materials and sources
SV 03	Transport of radioactive materials and sources
SV 04	Waste and discharges
SV 05	Sealed radioactive sources
SV 06	Gas chromatography with the help of a ^{63}Ni electron capture detector
SV 07	Open radioactive materials
SV 08	Highly active sources (HASS)
SV 09	Radionuclide laboratories
SV 10	Irradiation or treatment of laboratory animals with radionuclides
SV 11	Radiodiagnostic research in humans
SV 12	Devices
SV 13	Accelerators
SV 14	Fissionable materials and ores
SV 15	Contamination monitoring of open radioactive materials
SV 16	Leak testing of sealed and closed sources
SV 17	Notification
SV 18	Uranium-containing materials in small quantities25
SV 19	The use of ionizing radiation at varying locations in the Netherlands
SV 20	Radioactive demonstration materials

8. Radiological Areas

A radiological area is an area where radioactive sources or materials are used, where radioactive sources or materials are stored, where radioactive waste is stored, or where devices that emit ionizing radiation are installed.

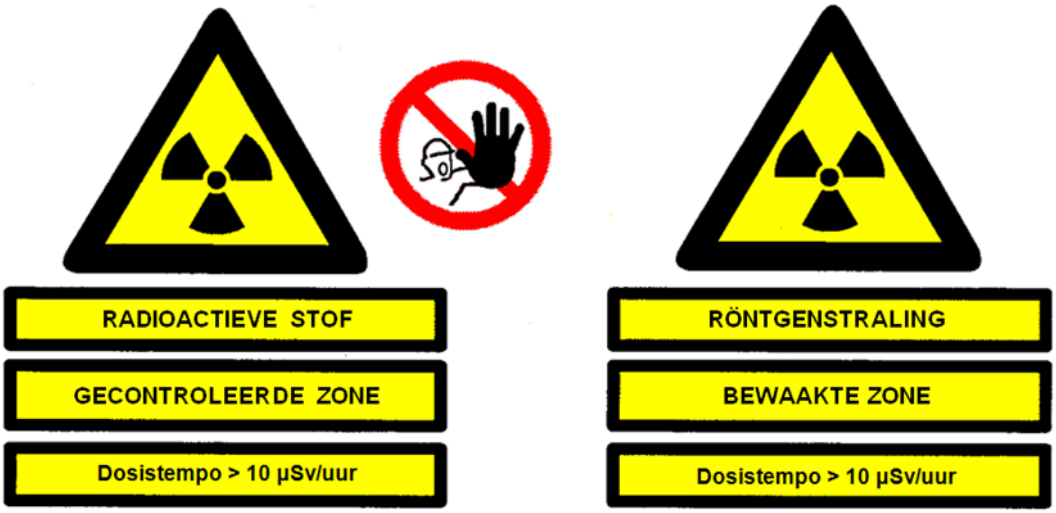
General access to radiological areas must be closed. Whenever it is theoretically possible that a yearly dose of 1 mSv may be received in an area, then that area should be declared a guarded zone. If a yearly received dose could be higher than 6 mSv, then the area should be declared a controlled zone. The access to these areas should be limited to exposed workers. The access door(s) of a guarded or controlled zone should be clearly marked with a warning sign for radioactivity.

Article 4.2 of the Regulation on Radiation Protection for Occupational Exposure 2018 describes the conditions to be met by the texts under the warning sign:

a. 'X-RAY-RADIATION', if a device is the cause of the possible exposure to ionizing radiation;
b. RADIOACTIVE SUBSTANCE', if a radioactive substance is the cause of the possible exposure;
c. 'SUPERVISED AREA' If it is a supervised area;
d. 'CONTROLED ZONE', if it is a controlled area.

If the dosage equivalent rate in the zone is more than 10 µSv/hour, the texts shall be accompanied by the clearly legible text: Dose rate > 10 µSv/hour.

Example of warning signs



Radionuclide laboratories
Radioactive materials in dispersible form may only be used within radionuclide laboratories. The labs must fulfill the design requirements as stated in a permit appendix covering this point. These requirements depend partially on the type of radionuclide laboratory (B, C or D), and these types are in turn determined by the nature and scope of the desired work proceedings in the laboratory.

In the Internal Permit, it is stated how much radiotoxicity equivalents maximally may be present and used in the radionuclide laboratory.

By or under the responsibility of the Radiation Protection Officer, regular contamination monitoring should be performed in the laboratory. The frequency of these controls depends on the nature and frequency of the proceedings in the radionuclide laboratory. If a radioactive contamination is found, then this should be decontaminated by or under the authority of the Radiation Protection Officer.

The request to withdraw an Internal Permit for working with radioactive materials in a radionuclide laboratory should proceed according to the internal regulations and procedures reported in the appendix “Radionuclide laboratories” in the permit. It is recommended to contact the General Coordinating Radiation Expert as soon as possible in case of dismantling a radionuclide laboratory.

It can happen that a radionuclide laboratory is to be removed. Before the area can be released for general purposes, a dismantling should first occur. Based on the history, measurements and wipe tests, it will be determined whether any remaining activity above the release limit is present. If necessary, measures can be employed to reduce the remaining activity to a level below the required level.

9. Personal Control Devices

All exposed workers (see 3.2.6) should wear personal control devices during their radiological work which records information about the cumulative radiation dose received during the work performed. The Radiation Protection Officer determines, together with the Radiation Commissioner of the entity in which the proceedings occur, which method of personal dose monitoring is necessary for a particular situation.

The RUG uses Thermoluminescence dose meters (TLDs) which are made up by name for each worker. Every four weeks, the Radiation Protection Officer, who is responsible for the application under which the exposed worker falls, changes the TLDs for a new one. The TLDs are then read by Mirion Technologies.

When a TLD is not suitable for dosimetry (for example, during the use of ^{3}H, ^{14}C of ^{35}S), the Radiation Protection Officer, if necessary, in consultation with the Radiation Protection Expert and/or the Radiation Commissioner and/or the Radiation Physician, will apply an alternative method for dosimetry. Exemption from the requirement for exposed workers to wear a TLD in this case can only be granted by the government.

To detect radioactivity during radiological work, a hand monitor should be used. An electronic personal dose meter (EPD) or a pen dose meter can be potentially used in addition to measure the radiation dose received during the proceedings.

10. Control and Enforcement

Risk inventory and evaluation (RI&E)
Prior to the granting of an Internal Permit for the use of radioactive materials or an ionizing radiation-emitting device, a risk inventory and evaluation will be assessed. Based on the result of this RI&E, the conditions are determined for working with the aforementioned materials or devices.

Acceptance inspection
Prior to the commissioning of a new or renovated radiological area or location, an acceptance inspection should be performed if this area has special requirements from the radiation protection viewpoint. The proper functioning of the protective measures and the extent to which the device conforms to the statutory provisions will be checked.

Periodic inspections
At least once per year, an inspection of the location given in the Internal Permit should take place. The SBE will arrange the inspection. The inspection will be performed using a checklist, on which the results of the inspection are given together with any potential agreements made and the action points that need to be taken. Deficiencies or situations that are not in accordance with the issued Internal Permit will have to be remedied within a reasonable period. In particular, the current status of the RI&E will be considered.

The inspections will be performed by one of the Central Experts together with a Radiation Commissioner from another entity. The Radiation Protection Officer should be present during the inspection.

Other inspections
In addition to the above-mentioned announced inspections, members of the SBE may also carry out unannounced inspections.

11. Radiation Incidents and Disasters

A written incident plan should be present for each application using radioactive materials, sources or ionizing radiation-emitting devices. In the plan, it states which measure should be employed for a radiation incident to counter further contamination and/or exposure of people.

The SBE provides a format that should be adapted by the Radiation Protection Officer for the specific, local, situation.

In case of missing radioactivity, or accidents or incidents with a radioactive material, source or an ionizing radiation-emitting device, exposed workers should warn the Radiation Protection Officer who has oversight of the respective application. The Expert should immediately contact the Radiation Commissioner of the entity and the General Coordinating Expert or his/her replacement.

Radiation incidents and disaster will be discussed and evaluated within the SBE, and improvement proposals will be made to prevent reoccurrence.

Appendix 1. Job descriptions of the members of the Radiation Protection Unit (SBE)

Job description "General Coordinating Radiation Protection Expert".

Goal of the function:

To form a coordination point in the organization with regards to radiation protection both within the RUG and externally.

Direct supervisor:

- Hierarchical: Head of Health and Safety Department
- Functional: n.a.

Gives direction to /coordinates the work of:

- Central Radiation Experts
- Radiation Commissioners

Nature of the direction: Functional

Main functions:

- Functions as the representative of the permit holder, i.e. the Executive Board, for the licensing and supervisory governmental authority;
- Chairman of the SBE, and in this capacity, ensures that the tasks of the SBE are performed and for the continuity of the Radiation Protection Unit;
- Formulates and prepares the radiation safety policy and advise on this policy within the confines of the Complex Permit;
- Supports the Radiation Commissioners and Radiation Protection Officers in their oversight of radiation safety within their entities;
- Exercises supervision or the organization thereof;
- Assesses and grants applications for Internal Permits, advises the Executive Board on this matter, and formulates the prescribed conditions;
- Ensures all regulative notifications and reports are sent to the licensing authority and permit holder.
- Providing an adequate and up-to-date company emergency plan and security plan for category 1, 2 and 3 substances and appointing a security officer.

Concrete activities:

- Maintain contact with the licensing and supervisory governmental authorities, on behalf of the Executive Board, including:
  - Ensuring periodic reports according to the provisions of the Complex Permit and laws and regulations;
  - Reporting changes and new application of radioactive materials and ionizing radiation-emitting devices within the framework of the Complex Permit, as well as requesting new permits as necessary;
  - Reporting radiation incidents according to the provisions of the Complex Permit and laws and regulations;
- Develop policy in the area of radiation safety for the RUG in addition to issuing generally applicable regulations;
- Shape and maintain an effective Radiation Protection Organization, sufficient to meet the permit conditions in all levels of the RUG;
- Ensure a consultation structure for the unit and coordinate the implementation of the radiation safety policy;

- Perform or oversee necessary administration tasks involving:
  - The purchase, use and disposal of radioactive materials and ionizing radiation-emitting devices, following up on the administration of the entities;
  - The "radiological" areas in use within the entire RUG;
  - Personal dose registration devices.
- Produce the annual plans and annual reports regarding the radiation safety of the entire RUG;
- Grant Internal Permits, if so mandated, or prepare for granting Internal Permits, to the faculty management for applications involving radioactive materials and ionizing radiation-emitting devices;
- Exercise oversight on the compliance with the provisions of the KEW, the Complex Permit, and Internal Permits;
- Organize and coordinate courses on radiation safety, including:
  - Draft or oversee the drafting of course programs and schedules;
  - Ensure the preparation of course materials;
  - Ensure or oversee arrangement of course locations and instructors;
  - Perform acquisition;
  - Draft budgets and make proposals for course fees or setting the fees;
  - Sending course administration to the Secretary of the AMD;
  - Participate in relevant national (exam) committees for the training of radiation experts.
  - To implement, if designated as responsible officer for security, the regulations in force for the security of radioactive materials category 1, 2 or 3.

The following guidelines and regulations are applicable for the execution of these tasks:

- The KEW with additional Decrees and Ministerial Regulations and, in this context, the requirements set by the licensing authority in the Complex Permit of the RUG
- The requirements set in the context of the Complex Permit of the RUG in the Radiation Safety Handbook of the RUG.

The following responsibilities and authority belongs to the function:

See Section 3.2.4.

The following education, additional training, skills, qualities and experience are required for the function:

- Academic level of working and thinking
- Diploma for Radiation Protection Expert Level 2 from a legally recognized educational program
- Registered in the required register of Radiation Experts. Participation in national and international activities to maintain knowledge and experience and thereby maintain the required registration.
- Sufficient experience with working with ionizing radiation.

Main functional contacts:

- Within the RUG
  - Executive Board
  - Faculty Board
  - Central Radiation Expert
  - Radiation Commissioners
  - Chief of Health, Safety and Environment Services
- External to the RUG
  - Licensing and supervisory governmental authorities
  - Radiation Physician

Job description "Central Radiation Protection Expert".

Goal of the function:

- To provide assistance to the General Coordinating Expert.

Direct supervisor:

- Hierarchical: Head of Health and Safety Department
- Functional: General Coordinating Expert

Gives direction to /coordinates the work of:

n.a.

Nature of the direction:

n.a.

Main functions:

- Co-formulates and prepares the radiation safety policy and co-advises on this policy;
- Participates in the SBE;
- Supports the Radiation Commissioners and Radiation Protection Officers in their oversight of radiation safety within their entities;
- Assists with the organization and coordination of radiation safety courses.

Concrete activities:

- Upon request of the General Coordinating Radiation Expert, contributes to the following activities:
  - Develop policy with regards to the radiation safety of the RUG, including drafting generally applicable regulations;
  - Ensure periodic notification according to the conditions in the Complex Permit;
  - Report changes and new applications of radioactive materials and ionizing radiation with the framework of the Complex Permit as well as request new permits;
- Prepare for granting Internal Permits;
- Perform or oversee various administrative tasks;
- Produce the annual plans and annual reports regarding the radiation safety of the entire RUG;
- Co-organize and coordinate courses on radiation safety.

The following guidelines and regulations are applicable for the execution of these tasks:

- The KEW with additional Decrees, Ministerial Regulations and ordinances, in this context, the requirements set by the licensing authority in the Complex Permit of the RUG
- The requirements set in the context of the Complex Permit of the RUG in the Radiation Safety Handbook of the RUG.

The following responsibilities and authority belongs to the function:

See Section 3.2.4

The following education, additional training, skills, qualities and experience are required for the function:

- Academic level of working and thinking;
- Diploma for Radiation Protection Expert Level 3 or coordinating expert from a legally recognized educational program;
- Sufficient experience with working with ionizing radiation;

- Registered in the required register of Radiation Experts;
- Participation in national and international activities to maintain knowledge and experience and thereby maintain the required registration.

Main functional contacts:

- Within the RUG
  - General Coordination Expert
  - Radiation Commissioners
  - Head of Health and Safety Department
  - Radiation Protection Officers
- External to the RUG

Job description "Radiation Commissioner".

Goal of the function:

To contribute to a well-coordinated organization with regards to radiation safety within the RUG in general and within the relevant entity in particular.

Direct supervisor:

- Hierarchical: Faculty Board
- Functional: General Coordinating Expert

Gives direction to /coordinates the work of:

Radiation Protection Officers

Nature of the direction:

Functional

Main functions:

- Coordinating the radiation safety within the entity;
- Participating in the SBE;
- Ensure compliance with the conditions connected to the authorization to perform radiological proceedings within the entity;
- Guide the preparation of an application for or change in Internal Permit and establish preconditions;
- Function as a contact point for the Radiation Protection Officers within the entity.

Concrete activities:

- Function as an intermediary on behalf of the faculty/faculties insofar as this relates to radiation protection within the entity;
- Co-draft applications for new Internal Permits or changes thereof and submit these for assessment and approval to the SBE; Nominate Radiation Protection Officers in conjunction with the Faculty Board;
- Produce the annual plans and annual reports regarding the radiation safety within the entity;
- Exercise oversight on the compliance with the provisions of the KEW, the Complex Permit, and Internal Permits. With regards to the applications within the entity, this concerns in particular:
  - Ensure that the tasks assigned to the Radiation Protection Officer are performed (giving instructions to the workers who use ionizing radiation, checking for radioactive contamination, periodically checking devices or sealed radioactive sources and the working conditions of the workers);

  - Check that the radionuclide administration of the Radiation Protection Officer is completed (administration of the radioactive material stream in the laboratories, including purchasing, disposal, discharge and logistics);
  - Ensure that the required Internal Permits are present and current;
- Maintain administration within the entity with respect to the current Internal Permits;
- Function as the chairman of possible consultations with Radiation Protection Officers within the working area.

The following guidelines and regulations are applicable for the execution of these tasks:

- The KEW with additional Decisions, Ministerial Regulations and Ordinances and, in this context, the requirements set by the licensing authority in the Complex Permit of the RUG
- The requirements set in the context of the Complex Permit of the RUG in the Radiation Safety Handbook of the RUG.

The following responsibilities and authority belongs to the function:

The functions of the Radiation Commissioner are a derivative of the mandate that the Faculty Board has with regards to ensuring radiation safety. The Faculty Board is mandated on behalf of the Complex Permit holder (Executive Board) to be responsible for compliance with the licensing regulations and legal provisions. In this responsibility, the Faculty Board is assisted by the Radiation Commissioner. See Section 3.2.4.

The following education, additional training, skills, qualities and experience are required for the function:

- Academic level of working and thinking;
- Diploma for Radiation Protection Expert Level 3 or Coordinating Expert from a legally recognized educational program;
- Registered in the required register of Radiation Experts or demonstrably possesses adequate competencies according to the judgement of the ACD;
- Participation in national and international activities to maintain knowledge and experience and thereby maintain the required registration;
- Sufficient experience with working with ionizing radiation.

Main functional contacts:

-	Within the Faculty	-	Radiation Protection Officers
		-	Faculty Board
		-	Exposed workers and other workers within the application who fall under the entity.
-	Within the RUG	-	General Coordinating Expert
		-	Other participants in the SBE

Job description "Radiation Protection Officer (Radiation Protection Officer)".

Goal of the function:

To supervise activities and/or applications with ionizing radiation falling under Internal Permits for which one as Radiation Protection Officer is appointed by the Executive Board.

Direct supervisor:

- Hierarchical: Faculty Board
- Functional: The Radiation Commissioner from the applicable entity

Gives direction to /coordinates the work of:

n.a.

Nature of the direction:

n.a.

Main functions:

- Manage sources, radioactive materials and devices;
- Instruct workers who work with radiation;
- Supervise on radiation safety within the application(s);
- Uphold emission limits;
- Disposal of radioactive materials, sources and devices;
- Function as a contact point or ensure a contact point for personal dose registration monitors of exposed workers within the application(s).

Concrete activities:

- Maintain the local KEW file;
- Produce the annual plans and annual reports regarding the radiation safety within the application(s);
- Ensure instruction of employees who work with ionizing radiation, the control of radioactive contamination and the working conditions of workers;
- Ensure compliance with the provisions relating to Internal Permits;
- Ensure the Internal Permit(s) are kept current and, if necessary, provide a substantive contribution to applications for change, granting or withdrawal this/these Authorization(s);
- Ensure/maintain records regarding:
  - Purchasing, use, and disposal/discharge of radioactive materials as well as the use of devices that emit ionizing radiation;
  - Periodic monitoring of devices and/or sealed radioactive sources;
  - Exposed workers and their received doses;
  - Radiologic areas that are in use;
- Function as a contact point for the radiation dosimetry of exposed workers.

The following guidelines and regulations are applicable for the execution of these tasks:

- The KEW with additional Decisions, Ministerial Regulations and Ordinances and, in this context, the requirements set by the licensing authority in the Complex Permit of the RUG
- The requirements set in the context of the Complex Permit of the RUG in the Radiation Safety Handbook of the RUG, as far as these applications are declared in the Internal Permit(s).

The following responsibilities and authority belongs to the function:

The functions of the Radiation Protection Officer are a derivative of the mandate that the Faculty Board has with regards to ensuring radiation safety. The Faculty Board is mandated on behalf of the Complex Permit holder (Executive Board) to be responsible for compliance with the licensing regulations and legal provisions. See Section 3.2.4.

Training, additional training, skills, characteristics, experience, etc. required for the job.

The training required depends on the situation. In principle, a supervisor who was trained after February 2018 must have completed a training course to become a 'Radiation Protection Supervisor' (TS) for a specific application. However, old training courses up to radiation expert levels 5, 4 and 3 are also permitted. A simple match between the old and the new training system is not possible.

Depending on the application, the supervisor must comply with the provisions of Internal Regulation IV14 with regard to the training and refresher training of radiation protection supervisors.

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Main functional contacts:

-	Within the Faculty	-	Exposed workers and other workers within the application
		-	Radiation Commissioner
		-	Faculty Board
		-	General Coordinating Expert
-	External to the RUG	-	n.a.

Job description "Radiation Physician".

The medical tasks in the area of radiation safety will be provided by an organization which provides services in occupational health and radiation safety such as defined in the Nuclear Energy Act (KEW). These tasks include:

- Ensure for medical oversight for A-workers as described in the KEW and the associated Acts and Regulations, in cooperation with the Health and Safety Department (AMD);
- Advise on the classification of exposed workers into Categories A and B, as defined in the Decree on Basic Safety Standard Radiationprotection (Bbs), on the basis of an assessment of the risk inventory and in cooperation with the General Coordinating Expert and, if necessary, the other members of the SBE and experts within the AMD;
- Upon request, participate in the meetings of the SBE;
- Advise in the event of radiation accidents and or incidents;
- If necessary, advise on or co-organize biological radiation monitoring;
- If desired and in cooperation with the members of the SBE and the Occupational Physicians of the AMD, provide information to workers who work with ionizing radiation;
- Advise the Occupational Physicians of the AMD on medical oversight as described in the Bbs;
- In some cases (e.g. for dose monitoring in accident situations) and in consultation with the General Coordinating Expert, liaise with relevant authorities.

Appendix 2: Important Names and Telephone numbers

Radiation Commissioners (if inaccessible: contact the General Coordinating Expert or the Central Expert):

Dr. R.J.H. Klein Douwel, Physics and Chemistry (Nijenborgh 3, 4 and 6)
Mobile: 06-44856952 Office: 050-363 **4931**

Dr. B.N. Jones, PARTREC/KVI (KVI, Zernikelnaan 25)
Mobile: Office: 050-363 3600

H. Havinga, Medical Sciences and Pharmacy (Antonius Deusinglaan 1)
Mobile: 06-10756273

Drs. E.J. Bunskoeke, Life Sciences (Nijenborgh 7)
Office: 050-363 **2410**

General Coordinating Radiation Expert:
Dr. H.F. Boersma, AMD, Visserstraat 49
Mobile: 06-22480002 Office: 050-363 5551

Central Radiation Expert:
Dr. A. Zandvoort, AMD, (Visserstraat 49)
Mobile: 06-44042128

J. Beiboer, AMD, Visserstraat 49
Mobile: 06-43247770

Physicians:
Radiation physician:
Dr. F.H.W. Jungbauer MD PhD
Mobile: 06-28559450

Occupational physician:
Drs. A. Ras, Coordination Occupational Physician, AMD, Visserstraat 49
Office: 050-363 **5534**

Other telephone numbers

- **General alarm number within the University of Groningen: 8050**
- **Alarmnummer UMCG/RUG ADL-1: 050- 363 3045**

- General number UMCG 050 - 361 6161
- National Poison Information Center (NVIC), RIVM tel. 030 - 274 8888

- ALARM-INCIDENT NUMBER ANVS tel. 088 – 489 00500 (Notification using this number may only be performed by members of the SBE).
- Non-emergency notifications ANVS: Via the website of ANVS. http://www.autoriteitnvs.nl/

Appendix 3. Definitions

Definitions are based on Bbs Annex 1, references to an article refer to the relevant article in the Bbs. Only definitions relevant for this handbook are described. Other defenitions can be found in the Bbs

devices or equipment: devices, accelerators, encapsulated sources and open sources as well as associated devices such as development machines, diagnostic monitors, PET/CT scanners and gamma cameras

A-worker: exposed worker as referred to in Article 7.11, second paragraph, in conjunction with Article 7.24

An A-worker is an exposed worker who:1°. may receive an effective dose greater than 6 millisieverts in a calendar year; 2°. may receive an equivalent dose greater than 15 millisieverts in a calendar year for the lens of the eye; 3°. An equivalent dose may be received that is greater than 150 millisievert in any calendar year for the skin averaged over any 1 cm2 area of exposed skin; or 4°. An equivalent dose may be received that is greater than 150 millisievert in any calendar year for the extremities.

storage: space used exclusively for the storage of radioactive materials

occupational exposure: exposure of workers at work

contamination: the unintended or undesired presence of radioactive substances on surfaces or in solids, liquids and gases or externally or internally in the human body

existing exposure situation: an exposure situation which already exists at the time when a decision on its monitoring is taken and which does not require, or no longer requires, urgent action

supervised zone: zone as referred to in Article 7.7, first paragraph, under b

b. an area is considered to be a supervised area, if: 1°. the possible effective dose to be received by a worker in space is greater than 1 millisievert in a calendar year and is less than or equal to 6 millisievert in a calendar year; 2°. the possible equivalent dose to be received by a worker in space, averaged over any exposed skin area of 1 cm2 , is greater than 50 millisievert in a calendar year and is less than or equal to 150 millisievert in a calendar year; or 3°. the equivalent dose likely to be received by a worker in space for the extremities is greater than 50 millisieverts in any calendar year and less than or equal to 150 millisieverts in any calendar year.

exposed worker: any worker who, as a result of work, may be exposed higher than the dose limits laid down in Article 7.3

a. An effective dose of 1 millisievert in any calendar year, and taking this into account: b. An equivalent dose: 1°. 15 millisievert in a calendar year for the lens of the eye; 2°. 50 millisievert in a calendar year for the skin averaged over any 1 cm2 area of exposed skin; and 3°. 50 millisievert in a calendar year for the extremities.

Exposure: the act of exposure or exposure to ionising radiation, whether external or internal.

source: appliance, accelerator or radioactive material

source according to RUG specification: a source of ionising radiation formed by radioactive material embedded in or attached to solid non-radioactive carrier material or surrounded by a casing of non-radioactive material. The carrier material or the casing provides sufficient resistance under normal conditions of use to prevent any dispersion of the radioactive material from the source. The containment of the source does not meet the requirements of the ISO 2919/1980 standard or an equivalent standard because:

1. the source is self-produced as a calibration or measurement source; or because

2. the activity of the source is less than 1 MBq, or because

3. the ISO 2919/1980 certificate is no longer available.

source holder: housing of an encapsulated source, which is provided with a device, at the source holder's exit window, to interrupt the exit beam and from which the source cannot be removed without the use of an auxiliary tool

B-employee: exposed worker as referred to in Article 7.11

A B-worker is an exposed worker who is not classified as an A-worker.

complex licence: licence as referred to in Article 3.4(4) for extensive practices or practices requiring extensive protection against ionising radiation

If within a location, under the responsibility of an entrepreneur, several actions take place that belong to different categories of actions referred to in Article 3.8 or 3.10, a permit is required for all of these actions, with the heaviest source determining the procedure applicable to the application. With a view to proper implementation, Our Minister may lay down more detailed rules and stipulate that a complex licence shall be required in designated cases.

expert: a person who has obtained a diploma or other certificate on completion of a training course in the field of radiation protection at an institution as referred to in Article 5.11

Institutions from which persons may obtain a diploma, certificate or other certificate on completion of training in radiation protection in accordance with Articles 5.5, 5.8 or 8.4(3) shall be recognised by the Authority. Recognition shall be for a period of five years and may be renewed for further periods of five years if the requirements for recognition referred to in paragraph 3 are met. An acknowledgement or renewal thereof shall be published in the Netherlands Government Gazette. 2. Recognition may be suspended or revoked

dose limit: value of the effective dose (or, where appropriate, the effective dose monitored) or the equivalent dose in a specified period which may not be exceeded on an individual basis

controlled area: area as referred to in Article 7.7 paragraph 1, under a

an area shall be considered a controlled area, if: 1°. the effective dose likely to be received by a worker in space is greater than 6 millisieverts in any calendar year; 2°. the equivalent dose likely to be received by a worker in space for the ocular dose is greater than 15 millisieverts in any calendar year; 3°. the equivalent dose likely to be received by a worker in space averaged over any 1 cm2 area of exposed skin is greater than 150 millisieverts in any calendar year; 4°. the possible equivalent dose to be received by a worker in space for the extremities is greater than 150 millisieverts in a calendar year; or 5°. there is a possibility of dispersion of radioactive substances from space such that individuals may receive a dose greater than the effective or equivalent dose referred to in Article 7.3, first paragraph.

practices: a human practice that may increase the exposure of individuals to radiation from a source and which is identified as a planned exposure situation under Article 6.17, including the preparation, holding, processing, application or disposal of a source

High Activity Sleaed Source: sealed source as referred to in section 4.3.3, the activity of which of the radionuclide contained therein is equal to or greater than the relevant value for that activity listed in Annex 4

sealed source: a radioactive source whose radioactive material is either permanently encapsulated in a sheath or bound in a solid form in order to prevent any dispersion of radioactive material under normal conditions of use

location: establishment as designated pursuant to Section 1.1(3) of the Environmental Management Act or place where an action is carried out

Categories of establishments which may cause adverse effects on the environment are designated by order in council.

discharge: discharge on or into the ground, air, public sewer or surface water

measurement, control or calibration source: source used exclusively in a measurement, control or calibration facility, fixed or otherwise.

open source: source other than an encapsulated source and other than a device or accelerator

storage: holding radioactive material, including spent fuel, a radioactive source or radioactive waste in a facility with the intention of retrieval

potential exposure of workers: potential exposure, other than regular exposure of workers, as a result of foreseeable unintended events, which has been determined approximately prior to the start of the activities within the framework of the risk inventory and evaluation, as referred to in Article 5 of the Working Conditions Act.

- When carrying out the working conditions policy, the employer shall record in writing in an inventory and evaluation which risks the work entails for the employees. This risk inventory and evaluation shall also contain a description of the hazards and risk reduction measures and the risks for special categories of workers.

- In the risk inventory and evaluation, attention shall be paid to the access of employees to an expert employee or person, as referred to in Articles 13 and 14, or to the occupational health and safety service.

- A plan of approach, indicating the measures to be taken in relation to the risks referred to and their relationship, in accordance with Article 3, shall form part of the risk identification and evaluation. The plan of approach shall also indicate the timeframe within which these measures will be taken.

- The risk identification and evaluation shall be adapted as often as experience, working methods or working conditions, or the state of the art in science and professional services so require.

- If the employer has work carried out by an employee who is made available to him, he shall, in good time before the start of the work, provide the person who makes the employee available with the description from the risk inventory and evaluation of the hazards and risk reduction measures and of the risks to the employee at the workplace to be taken, so that the person provides this description to the employee concerned.

- The employer shall ensure that each worker can take note of the risk identification and evaluation.

radioactive source: source containing radioactive material to be used for its radioactivity

regular exposure of workers: expected exposure, other than potential exposure of workers, resulting from normal operating conditions, including maintenance, inspection and decommissioning, which has been approximated before the start of operations as part of the risk inventory and evaluation referred to in Article 5 of the Working Conditions Act

Radiation protection expert: an expert referred to in Article 5.4 who has the necessary knowledge and experience and has received the necessary training to give radiation protection advice, with a view to the effective protection of persons, and whose competence in this field is recognised in accordance with Articles 5.5 or 5.6.

1. As regards the radiation protection expert, in addition to the general provisions of this section, the specific provisions of Chapters 6, 7, 8 and 9 shall apply. 2. An operator performing or having performed a practice which requires licensing, registration or notification shall ensure that a radiation protection expert advises him on, or supervises, compliance with the rules and regulations laid down by or pursuant to law and this Decision in relation to that practice if it involves or may involve occupational exposure or exposure of a member of the public. The first sentence shall also apply to any measure or exposure situation for which notification is required. 3. With regard to actions as referred to in subsection 2, expertise shall be required in accordance with an appropriate level laid down by regulation of Our Ministers, which shall be proportionate to the nature and seriousness of the risks involved. 4. The regulations referred to in subsection 3 may lay down further requirements with regard to the appropriate levels of expertise referred to in that subsection. 5. A radiation protection expert may be assigned by a civil servant designated in Section 58 of the Act to protect workers and members of the public against ionising radiation.

Radiation incident: unintended event or situation or unintentional dispersion in which there is or has been a risk of:

- an exposure to ionising radiation of members of the public in excess of 0.1 millisievert

- a discharge on or into the soil, sewers, surface water or air above a value determined by Our Minister

- an exposure to ionising radiation of workers in excess of 2 millisievert

Radiation position: the position in which the radioactive source or substance is located under normal conditions of use

apparatus: apparatus capable of emitting ionising radiation and not containing radioactive material, nuclear fuel or ore

radiation protection supervisory employee: employee as referred to in Article 5.7 who is technically competent in the field of radiation protection for a particular type of activity to supervise the application of the radiation protection measures or to implement these measures

1. In addition to the general provisions of this section, the specific provisions of Chapters 6 and 7 apply with regard to the supervising radiation protection officer. 2. An operator performing or having performed a practice that involves or may involve occupational exposure or exposure of a member of the public shall ensure that this practice is performed by or under the supervision of a radiation protection officer. 3. The duties of a radiation protection officer may be carried out by a radiation protection expert or a radiation protection unit. 4. The employer shall ensure that a radiation protection supervisor working in his undertaking: a. receives adequate education, training and information in the field of radiation protection specific to the application, and b. receives regular application-specific continuing education and training. 5. The employer shall keep records documenting the manner in which the fourth paragraph is implemented and shall keep these records available to the officers appointed pursuant to Section 58 of the Act. 6. By regulation of Our Ministers, requirements may be laid down with regard to the knowledge, skills and abilities of a radiation protection supervisory employee for the applications referred to in the fourth paragraph and the education, training and information referred to in the fourth paragraph. These may include requirements relating to the attendance of training courses. 7. Detailed rules may be laid down in a regulation of the Authority to ensure proper implementation.

radiation protection supervisor: employee charged with the implementation of the radiation protection policy and supervision within his/her application.

accelerator: any device or installation that accelerates particles and emits ionising radiation with an energy higher than 1 mega-electron volt (MeV).

having available: holding, managing, storing or otherwise actually possessing, or manufacturing, processing, handling or storing, with the exception of holding in connection with storage in connection with transport

Part II Radiation Protection Regulations University of Groningen

1 Procedures

P 01 Processing and assessment of the Request for an Internal Permit

The application for granting, withdrawal, change or extension of an Internal Permit should be submitted to the Radiation Protection Unit (RPU, SBE).

The SBE records the date the application was received and assigns a number to it. The application is not admissible if the application is incomplete or unclear, or if it has not been approved by the Radiation Commissioner from the appropriate entity. In this case, the applicant will be given the opportunity to correct these deficiencies.

During the annual meeting in 2019 between the Ph resources and the General coordination RPE it was agreed that the radiation commissioner of the entity concerned may sign Internal permit applications, changes and terminations on behalf of the Ph resources concerned. The Ph resources will be notified by e-mail of the relevant Internal Permit after the application, modification or termination of an Internal Permit has been processed.

The SBE assesses the application for the granting of an Internal Permit on the following points:

a. Is the request possible within the Complex Permit of the RUG?
b. Is the use of radioactive materials or ionizing radiation-emitting devices justified in the application? Do alternatives exist and if so, why were these not chosen?
c. Do the locations where the applications will be performed fulfill the requirements that were set in Part II of the RSH? The relevancy of storage units will also be considered.
d. Do the work instructions and regulations, and any maintenance instructions offer sufficient guarantee for radiation safety in general and (radiation) safety of the workers in particular?
e. Are the prescribed safety measures and the emergency plan adequate?
f. Is it known who the exposed worker is or will be? Are the exposed workers classified in the correct categories?
g. Are the correct emissions to the environment reported?
h. Has sufficient substance been given to the ALARA-principle targeting the protection of workers and other people, the environment, and the limitation of waste?
i. Will any legally set dose limit or dose constrain be exceeded?
j. Can the intended Radiation Protection Officer honor his/her obligations with regards to administration and oversight?
k. If applicable: will all the regulatory requirements be fulfilled concerning highly active sources or for the safeguarding of radioactive material?

If the location where the application will take place is not explicitly given in the Complex Permit or the relevant application or is not part of the area of one of the four entities, the application will also be assessed on the following points:

l. If applicable: is it plausible that the application can not take place within the locations named in the Complex Permit or associated applications can occur[2]?
m. Is any Secondary Level exceeded, where relevant taking into account actions involving ionizing radiation by other entrepreneurs?

The SBE assesses the application for change of an Internal Permit only on the requested change, and therefore pays attention, if applicable, to the above-mentioned points.

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[2] See for more information **IV12 Granting Internal Permit for using ionizing radiation at varying locations in the Netherlands**

The SBE assesses the application for extension of an Internal Permit only on those points that earlier have given rise to the issuance of an Internal Permit for a definite period. The SBE therefore pays attention, if applicable, to the above-mentioned points.

The SBE assesses the application for withdrawal of an Internal Permit on the following points:
a. If the application is a radionuclide laboratory: is the laboratory dismantled according to the Directive for Radionuclide laboratories? Is a written report available?
b. If the application is a closed source or device: has the device or the source been properly disposed of?

If the SBE judges negatively on *one* of the points listed above, then the application should be adjusted in consultation with the applicant such that the criteria of the SBE can be fulfilled.

If these criteria are met, then the SBE will judge the application positively and the General Coordinating Expert will grant the Internal Permit. If applicable, the Executive Board will be advised to appoint a Radiation Protection Officer.

If the opinion of the SBE is not unanimous, the General Coordinating Expert makes the decision, and the members of the SBE who had a negative opinion about the application can submit arguments in writing.

The applicant and the Radiation Protection Officer will be informed of the decision of the SBE. The SBE will arrange for further administrative processing.

If the SBE gives a negative decision, the applicant can request that the application be assessed by the Executive Board. In this case, the SBE argues its negative decision to the Executive Board. If the Executive Board, notwithstanding the negative decision of the SBE, grants the internal agreement, the members of the SBE are obliged to notify the Authority on Nuclear Safety and Radiationprotection (ANVS) and inform the Executive Board of this notification.

The SBE strives to complete the entire procedure with five weeks, calculating from the moment that the final application has been submitted.

P 02 Classification of exposed workers

This procedure provides guidelines for the classification of exposed workers. The general regulation **AV6 Classification of Exposed Workers** applies.

The classification of exposed worker follows from the evaluation of the risks as laid down in the RI&E. Individuals who may be professionally exposed to an effective dose greater than 1 mSv per year, or an equivalent dose greater than 15 mSv (lens of the eye) or 50 mSv (skin and extremities) per year respectively, shall be considered exposed workers.

In principle, the following people could be counted as exposed workers:
- Radiation Protection Officers, Radiation Commissioners and Central Radiation Experts,
- Employees and students who work with ionizing radiation or assist in radionuclide laboratories or in equivalent areas, and/or who use ionizing radiation-emitting devices,
- Employees who perform maintenance on the associated installations or on ionizing radiation-emitting devices in radionuclide laboratories or in equivalent areas,
- Are student or Intern.

Exposed workers are divided into two categories, i.e. category A and B.

- A-workers are those to whom the criteria below applies:
  - The person is likely to receive a total effective dose of more than 6 mSv per year due to external irradiation and internal contamination, or
  - There is a chance that the individual will receive an equivalent dose of more than 15 mSv per year on the lens of the eye or 150 mSv per year on the skin or extremities.
- B-workers are persons to whom the criteria below applies and who, moreover, do not fall under category A employees:
  - There is a chance that the persons concerned will receive an effective dose of more than 1 mSv per year, or
  - There is a chance that the individual will receive an equivalent dose of more than 50 mSv per year on the skin or extremities.

In special circumstances, exemptions from the above guidelines can be granted by the General Coordinating Radiation Expert upon request by the Radiation Protection Officer. The request should consist of written arguments that have been approved by the Radiation Physician. People who work with the following are not considered radiological workers:

- electron microscope,
- X-ray diffraction devices equipped with adequate protective housing, and
- devices that are shielded such that no radiation dose of more than 1 mSv per year can occur, and
- such maximum quantities of radioactive materials that no radiation dose of more than 1 mSv per year can occur.

Everyone who is classified as a radiological worker must wear a control device during working with radioactivity, as described in the general regulations **AV07 Personal Control Device**s.

P 03 Internal Permit inspections

Regular inspections
Every application of radioactive radiation or ionizing radiation-emitting devices for which an Internal Permit is given must be inspected at least once per year. This inspection should be performed by one of the Central Experts and a Radiation Commissioner from another entity than the one in which the application occurs. During the inspection, it will be checked whether the authorization holder has fulfilled the requirements stated in the Internal Permit. The Radiation Protection Officer should also be present during the inspection.

During or prior to the inspection, the **Digital KEW File** will be checked to ensure that it is up-to-date. In addition, if applicable, the following points will also be addressed:
- Does the RPO fulfils the requirements for following refresher course?
- Are the location where the application occurs and the radiological proceedings that occur, still in agreement with the Internal Permit?
- Is there an arrangement for a replacement in the absence of the Radiation Protection Officer?
- Are there work instructions present?
- Is there a safety manual/incident plan present?
- Are the laboratories technically in order (i.e. do they conform to the Guideline for Radionuclide Laboratories (RRL), which are identical to the appendix Radionuclide Laboratories of the Complex Permit)?
- Is the storage place technically in order (according to RRL)?
- How often is the application used?
- When was the last check of the source or the device and what were the findings? In particular attention will be paid to the results of leakage tests and the measurement of dose rates around storage places, sources holders, equipment containing sources or ionizing radiation emitting equipment.
- How much of which nucleotide has been used in the past period of time?
- How much waste has been produced in the past period of time and how has it been disposed of?
- Is the justification for the application still valid or are there alternatives available?
- How has the ALARA principle been applied?
- Who are the exposed workers (or who has access to the application), are they wearing a badge, and what is the dose that they have received in the past period of time? Do these conform to the legally set dose limits?
- Do the exposed workers have sufficient expertise?
- Are the exposed and non-exposed workers who use the application sufficiently trained and do they follow the instructions?
- Is the risk inventory, on which the Internal Permit is based, still accurate?
- What have the emissions to the environment been in the past year?
- Have any incidents or accidents occurred in the past period of time?
- What is the general impression of the radiation safety discipline within the application?
- Have there been improvements made in the situation since the previous inspection? Have the agreements concluded previously been realized?

The findings of the Central Expert and the Radiation Commissioner should be reported as soon as possible after the inspection using the form **F06 Inspection Report**. The Radiation Protection Officer, the inspecting Radiation Commissioner, and the Central Expert should all sign the report. A copy of the report should be sent to the Radiation Protection Officer and the Radiation Commissioner of the entity.

If shortcomings are reviled during the inspection, agreements with the Radiation Protection Officer should be made to improve these shortcomings. A deadline for improvement of each shortcoming will

be imposed. Monitoring compliance with the agreements should occur by means of monitoring visits performed by the Radiation Commissioner of the entity and by discussing the shortcomings and progress during the meetings of the SBE. The procedure is described in detail on the next page (PDCA-cycle).

During a visit, if it is shown that an application has not been used for a long time and will not be used anymore, the authorization holder will be urged to submit an application for withdrawal of the Internal Permit.

The results from the inspection report are used in the compilation of the annual report on radiation protection prepared by the SBE. If applicable, the supervisor must also send an annual statement for open substances and/or sealed sources before 1 March each year. The annual report on radiation hygiene is presented to the Executive Board by the SBE. The inspection report and any annual statement therefore serve as a report from the supervisor to the Executive Board.

A summary of the results of the inspections is (anonymously) included in the annual report of the SBE.

Other inspections
In addition to the regular inspections, the SBE also conducts unannounced inspections. These may be performed by one of the Central Experts, a Radiation Commissioner from a different entity, or a Radiation Commissioner from the same entity. The General Coordinating Radiation Expert ensures within this framework that each entity is visited at least once per year by someone other than the Radiation Commissioner from the same entity.

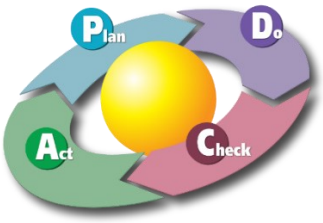
The other inspections can have an influence on all aspects of radiation protection as stated under regular inspections section, but can also be aimed at only one specific aspect.

The inspecting radiation expert creates a report of his findings and sends this in writing either by post or email to the General Coordinating Expert, who ensures that a copy is sent to the Radiation Protection Officer and, if applicable, to the Radiation Commissioner of the entity.

If shortcomings are found, these will be dealt with by regular inspections.

A summary of the results of the unannounced inspections should be included (anonymously) in the annual report of the SBE.

PDCA cycle for conducting audits/work visits



Audits are performed annually.
Objective: compliance with law and regulations

PLAN

- Based on the results of the previous year, it is determined whether alterations to the audit form, procedures or regulations are necessary.
- Audit is planned with the auditor and auditee .
- Key points and points of attention are determined within the safety organization.

DO

- The digital folder of the group concerned is checked by the auditor(s).
- The physical audit is being performed.
- Both the digital folder and the physical location or application are discussed.
- During the audit, an audit form is completed and action points are identified.

CHECK

- The auditee receives the report including action points and the date by which the point must be resolved.
- The central organization checks whether action points have been completed within the set deadline.

ACT

- If action points are still open after the specified date, the Central Organization will send one reminder to the local expert.
- If the action point has not been dealt with after 1 reminder, the entity expert will be informed to take action.
- Failure to address action points may result in a formal warning or shut-down of the application or lab.
- Evaluation of audit-related procedures, regulations and policies.

P 04 Exposer at multiple employers

Radiation safety and communication procedures for UMCG employees working in RUG radiological rooms [3].

Employees who perform activities with ionizing radiation within RUG radiological areas work at that location under the KEW permit of the RUG. The direct supervision of radiological activities and exposure at those locations falls under the University of Groningen KEW permit, which is managed by the SBE-RUG.
Employees employed by the UMCG can work in both the RUG and UMCG radiological rooms and be exposed to ionizing radiation at both locations.

This document describes the agreements that have been made about sharing exposure information, the classification of employees as exposed employees and how an excessive exposure or incident is reported if it concerns employees of the UMCG working in a RUG radiological room.

1. Classification of the workers as not exposed, A or B worker

The potential dose is determined on the basis of the RI&E of the locations where the employee works. This means that the dose is considered at both the UMCG and the RUG locations. Both the effective (subsequent) dose and (where relevant) the skin and eye lens dose are assessed.
If a UMCG employee wants to perform actions within a RUG radiology room, the SBE-RUG will act in accordance with the following schedule, whereby 'exposure' is understood to mean 'potential exposure cf. RI&E':

- Category classification based on RUG RI&E alone:
    - **unexposed worker:**
        - no radiological work at UMCG: →no action
        - radiological work at UMCG, but exposure at RUG lower than attention value (or not classified): →no action
        - radiological work at UMCG, exposure at RUG higher than attention value: inform SBE-UMCG
    - **exposed worker category B:**
        - no radiological work at UMCG: →no action (possibly annual report on exposure)
        - radiological work at UMCG, but RUG exposure lower than attention value and not classified at UMCG: →no action (possibly report annually on exposure if not classified at UMCG)
        - radiological work at UMCG →do act in accordance with the procedure (next page).
    - **exposed worker category A:**
        - Radiological work at UMCG: →report to SBE-UMCG for examination by radiation doctor; annual reporting to SBE-UMCG
        - there are radiological work at the UMCG (regardless of classification): act in accordance with the procedure (next page).

Attention value: 10% of the relevant dose values.

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[3] *This procedure also applies if RUG employees in UMCG radiological rooms carry out activities with ionizing radiation whereby the responsibilities and obligations of the RUG and UMCG described in this procedure are reversed. Where RUG is then read UMCG and vv.*

Relevant dose values:

Employee	Effective dose	Extremity dose	Eye lens dose
Not exposed	1 mSv*	50 mSv*	15 mSv*
B worker	6 mSv	150 mSv	15 mSv
A worker	20 mSv*	500 mSv*	20 mSv*

* Dose limit

Procedure:

- The SBE-RUG reports the relevant UMCG employee to the SBE-UMCG, stating the name, UMCG department, exposure category and potential exposure.
- If desired by the SBE-UMCG, the SBE-RUG provides insight into the RI&E of the UMCG employee within RUG radiological areas.
- Together with the department's radiation expert, the SBE-UMCG determines what the exposure is within the UMCG on the basis of the RI&E.
- The SBE-UMCG sums up the potential exposure at UMCG and RUG locations and assesses which exposure category is appropriate.
- The SBE-UMCG informs the SBE-RUG about the (possibly revised) classification of the employee (employees are placed in the same exposure category at both locations (UMCG and RUG).
- If desired by the SBE-RUG, the SBE-UMCG provides insight into the RI&E of the UMCG employee within UMCG radiological areas.
- If the summed exposure of the UMCG employee leads to the classification of exposed A employee, this employee will be reported by the SBE-UMCG to the A&G-UMCG department for a radiation examination by the UMCG radiation physician.
- The SBE-UMCG shares a copy of the radiation test with the SBE-RUG.
- Unregistrations of UMCG employees, who have been reported to the SBE-UMCG as an exposed employee at the UG location in accordance with this procedure, are passed on by the SBE-RUG to the SBE-UMCG.

2. Official personal dosimetry

The RUG has its own personal dosemeters for employees working in RUG radiology rooms. Employees can be asked by both the SBE-RUG and the SBE-UMCG to wear an electronic personal dosimeter during specific activities in order to verify the application dose.

- The UMCG employee does not wear the UMCG TLD in RUG radiological rooms.
- Only the RUG TLD is worn during work in RUG radiological rooms, possibly in combination with a ring dosemeter if the outcome of the RI&E prescribes this.
- The TMS-RUG ensures that the TLD is worn correctly, if necessary in combination with a ring dosemeter.
- The SBE-RUG checks the periodic TLD dose reports for deviating dose values. For the SBE-UMCG, the total dose of all dose subscriptions together can be viewed on the periodic TLD dose reports that the SBE-UMCG receives from Mirion.
- The dose data of UMCG employees who only wear a TLD within RUG radiology rooms (i.e. who are not an exposed employee in the UMCG) will be shared with the SBE-UMCG after an investigation by the SBE-RUG if an effective dose value of 0 is exceeded. 0.3 mSv per period.

3. Overexposure and incidents

The activities within RUG radiological areas take place under the KEW permit of the RUG. There is a shared responsibility for worker safety and personal dose determination. The UMCG must be informed about the risks of the work at RUG locations and, in the event of excessive exposure or incidents, be informed and involved in such a way that it can fulfill its obligations under the Nuclear Energy Act and towards the employee.

- Excessive exposures and incidents involving UMCG employees within RUG radiological areas are reported by the SBE-RUG to the ANVS/SZW within 24 hours in accordance with the legal provisions. In addition, a copy of this report is shared with the SBE-UMCG.
- The SBE-RUG analyzes the circumstances of the incident and shares the findings with the SBE-UMCG.
- The SBE-RUG is responsible for dealing with the authorities, unless the authorities decide otherwise.

2 Internal Regulations

IV 01 Annual Report SBE

Every year, the SBE composes an annual report for the Executive Board. This annual report should be prepared as soon as possible (and ultimately within six months after the end of the report year) and sent to the licensing authorities.

The following items should be included in the annual report:

- An overview of the Internal Permits that have been newly granted, changed or withdrawn, and any internal Notifications.
- An overview of the current Internal Permits and internal Notifications, their locations and the Radiation Protection Officers.
- An overview of all the ionizing radiation-emitting devices and sealed sources (including fissionable materials and ores) which are present on 31 December of the report year.
- The inventory of open radioactive materials (including fissionable materials and ores) on 31 December of the report year as well as the purchasing records thereof.
- The results of the inspections, identified deficiencies and implemented improvements.
- An overview of the number of exposed workers and their radiation doses accumulated during the report year.
- The emissions to the environment in the report year.
- The present and disposed amount of radioactive waste.
- Any incidents and unexpected happenings during the report year.
- An overview of the changes in the **Radiation Safety Handbook, Radiation Protection Unit, RUG** (including the **Radiation Safety Regulations RUG**). The overview should indicate if any of these changes have affected the permit requirements and how these requirements were fulfilled. The remaining changes can be given to the licensing authorities in a Notification.
- A working plan for the coming year.

The annual report should be sent to:

Authority Nuclear Safety and Radiation Protection (ANVS)

IV 02 Changing documents that are an integral part of the Complex Permit

The documents in this regulation that are related to the Complex Permit are:

- All parts of the Radiation Safety Handbook RUG (HSR) including the Radiation Safety Regulations RUG;
- Safety reports that are specified in the Complex Permit.

The addition of new chapters to the HSR shall be considered as changes.

If a change relates to:
- the intention to apply ionizing radiation outside of the locations covered by the current Complex Permit, and this doesn't fit in the area that the current Complex Permit offers, or;
- the intention to apply ionizing radiation to an extent that exceeds the current Complex Permit,

then this can only be accomplished *after* the Complex Permit is changed accordingly. The Complex Permit need not be changed if the intended application is not subject to licensing.

Taking into account the aforementioned together with the regulations from the current Complex Permit, any changes should be reported to the Authority Nuclear Safety and Radiation Protection,

In the following cases, the SBE shall always submit changes of documents to the government:

- if the current regulations are relaxed and this has not occurred as a consequence of the implementation of new laws and regulations;
- if the existing safety report must be updated as a result of new research directions.

All other changes should be reported to the government by including the changes in the annual report (see internal regulations **Annual Report**). The changed documents should be sent along with the annual report, preferably digitally, if possible.

IV 03 Contents of the Central Nuclear Energy Law (KEW) File

The digital KEW File can be found on the y-drive (RADMIN) of the Health and Safety Department and consists of the following parts:

- Complex Permit
- Application for the Complex Permit + all explanations
- Radiation Safety Handbook RUG, including the Radiation Regulations RUG
- Applications for granting, changing, or withdrawal of Internal Permits with accompanying documentation
- Internal Permits
- Map of the building with the location of the laboratory, device or source indicated
- Inspection reports
- The data, on the basis of which the Annual Report, as described in the **Annual Report SBE**, can be composed
- Reports of missing radioactivity, accidents and disasters
- Official correspondence
- Data concerning exposed workers including registered doses and test results

The General Coordinating Expert is responsible for keeping the Central KEW File current and up-to-date.

All documents should be kept at least for five years. Medical files of exposed Category A workers have a different retention period. These files should be kept until the person turns 75 years of age and at least for 30 years after the proceedings have ended.

All portions of the Central KEW File are kept digitally by the SBE. Digital files can be found at the specially equipped Y-drive structure (RADMIN and ARBO-SBE).

IV 04 Contents of the Entities Nuclear Energy Law (KEW) File

The Entities KEW File, or entity file, can be found with on RADMIN on the y-drive under the Radiation Commissioner file of the relevant entity and consists of the following documents:

- Radiation Safety Handbook RUG, including Radiation Regulations RUG
- Copies of Internal Permits as well as withdrawal decisions that have been given for applications within the relevant entity
- Reports of missing radioactivity, accidents and disasters within the relevant entity
- Official correspondence regarding the relevant entity

In addition to the above, the Entity File should preferably contain
- Applications for granting, changing or withdrawal of the relevant Internal Permit with accompanying documents

The Radiation Commissioner is responsible for keeping the Entity File current and up-to-date. Reports and correspondence should be kept at least five years.

All portions of the Entity KEW File are kept digitally by the SBE. Digital files can be found at the specially equipped Y-disk structure (RADMIN).

IV 05 Radiation incidents

If a Radiation Protection Officer informs the General Coordinating Radiation Expert about a radiation incident, as described in the general regulations **Missing, Accidents and Disasters**, then the following Inspectorates should be informed as soon as possible by the general coordinating Radiation Protection Expert:

- Urgent report ANVS: Radiation incidents, non-nucleair phone: **088 489 0500** (Reports only by members of the SBE).
- NON-urgent reports ANVS: Via the website of ANVS. http://www.autoriteitnvs.nl/ (Reports only by members of the SBE).

In addition to the above, the current Complex Permit (via the regulations dating from 2012) also requires that, in such a situation, the SZW Inspectorate and the Environment and Transport Inspectorate be informed immediately via the alarm incident number 070 - 383 2425. In 2019, this is the ANVS crisis number for advising government organizations. If a radiation incident is reported to the ANVS via the 088 number, the general coordinating radiation expert will therefore inform the ANVS if, and if so in what way, additional reporting is required.

IV 06 Ordering and Receiving Radioactive Materials and Sources

Radioactive materials and sources may only be ordered and received by, or under the authority of, the Radiation Protection Officer. The Radiation Protection Officer should ensure that no one other than himself/herself or his/her replacement places an order or receives the shipment. He/she can ensure this by using the following method.

Instruction for users of radioactive materials and sources

It is not permitted to order radioactive materials or sources on your own initiative. Usually, you can ask the Radiation Protection Officer to place an order for you. Please give the following information: supplier, name of the radioactive material or source, catalog number, activity, desired date of receipt, and the cost. If the desired activity falls within the limits of the Internal Permit, and if the Radiation Protection Officer agrees that the user is allowed to handle the material or source (after assessing, for example, what the expected risks are), then the order will be placed. After receiving the order and after the Radiation Protection Officer registers the radioactive material or source, the user will be informed that the radioactive material has arrived.

The Radiation Protection Officer is responsible for the implementation of what is stipulated in regulation **SV01 Purchasing of Radioactive Materials and Sources**. The following instructions should be used for the implementation:

Instructions for the Radiation Protection Officer

The Radiation Protection Officer verifies whether the requested radioactive material or source falls within the activity level and type specified in the Internal Permit for which he/she is responsible. If the Radiation Protection Officer agrees with the application of the material or source by the user and if there are no other objections, then the Radiation Protection Officer will place the order. He/she initials the order, even when it is a written order confirmation following a telephone order.

The Radiation Protection Officer records the planned date and time of delivery on the order or confirmation, taking into account the opening hours of the building in which the laboratory is housed as well as his own presence. Upon delivery, the radioactive material or source should be received as soon as possible by the Radiation Protection Officer, secured in a safe, and entered in the register. Only undamaged packages are accepted. Possible contamination on the outside of the package is excluded by preforming a wipe test.
The packaging should be tested for the absence of contamination and after removal of the labeling, should be disposed of in the non-radioactive waste. The intended user and the purchasing department should be notified of the delivery.

The Radiation Protection Officer can give the above instructions in writing to a nominated replacement who then acts in accordance with the above instructions.

The General Coordinating Radiation Expert or the Radiation Commissioner should inform the building concierges and employees of the stores and/or purchasing department that radioactive materials and sources may only be ordered and received by, or under the authority of, the Radiation Protection Officer. In this regards, the following instructions should be used:

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Instructions for the logistic department and/or stockroom

The ordering of radioactive materials or sources is a strictly-regulated process. In general, research groups may not use and/or have radioactive materials or sources in their possession without the required Internal Permit under the context of the Complex Permit Nuclear Energy Act of the RUG. Random employees thus may not place any orders for radioactive materials or sources.

Each purchase order of a radioactive material or source should be initialed by the Radiation Protection Officer who oversees the radiological proceedings, or by his or her officially designated replacement. For verbal orders placed by telephone, the written confirmation of the order should be initialed afterwards. Requests for ordering radioactive materials and sources by other people will be referred to the Radiation Protection Officer or, if it is unclear which Radiation Protection Officer should be involved, the Radiation Commissioner.

Arrival of radioactive goods

Stockroom Nijenborgh 4

Goods ordered for the isotope laboratory Biochemistry and Life Sciences are delivered to the goods stockroom of Nijenborgh. Reception takes place under the responsibility of the radiation protection supervisor of the laboratory concerned. The daily responsibility is carried out by a local employee with a minimum level of VRS-D or equivalent. Reception, storage and distribution takes place under a written protocol. Distribution staff are instructed on adequate handling and delivery to the laboratories concerned.

Medicine and Pharmacy

Externally ordered nuclides for the Pharmacy isotope laboratory or the Central Animal Facility (incl. Gronsai) are delivered to the logistic corner of ADL-1. Orders received at the logistic corner ADL-1 are immediately reported by the recipient to the radiation protection supervisor of the relevant laboratory. He/she will pick up the package as soon as possible. Until then, the package will be kept in a locked storage. Details regarding the receipt and distribution are contained in a written protocol.

Radionuclides produced by the cyclotron of the UMCG that are used for research within ADL-1 (Hotel Lab Pharmacy and Medical Sciences, CDP or Gronsai) are transported to ADL-1 in accordance with the transport protocol from the UMCG and are received there in accordance with the local reception protocol.

IV 07 Cleaning activities in radionuclide laboratories

Limitations to the regular cleaning activities in areas belonging to radionuclide laboratories are set to ensure safety of the cleaning staff.

Due to the nature of working in a laboratory where radioactive materials are used, specific instructions for cleaning staff apply with regards to access and allowable actions. New cleaning staff should report to the Radiation Protection Officer of the involved laboratory before performing any cleaning in a radionuclide laboratory or radiological area (which is recognized by the presence of at least the logo below). Cleaning staff should be personally instructed by the Radiation Protection Officer or his/her replacement before cleaning an isotope laboratory in the following:

- Access granted only by permission of the Radiation Protection Officer of the laboratory.
- Cleaning activities should only be performed using materials stored in the cleaning closet of the laboratory.
- Cleaning activities are limited to emptying trash cans without the warning label “radioactivity” (see below) and cleaning the floor.
- If uncertain about what should be done, ask first before doing.
- The Radiation Protection Officer may include other requirements for a B-laboratory (such as wearing shoe covers or control checks when leaving the laboratory).

Example of a warning label for radioactivity



Additional questions can be addressed to the Radiation Protection Officer of the laboratory.

The Radiation Protection Officer is instructed to follow regulation **SV 09 Radionuclides laboratory** regarding cleaning activities:

- Before cleaning activities in a radionuclide laboratory can occur, the Radiation Protection Officer should ensure for the clearing and decontamination, if necessary, of work spaces to be cleaned. The frequency of scheduled cleaning is available at the Facility Manager’s office. If the Radiation Protection Officer wishes to change the scheduled cleaning times, he/she should submit a request to the Facility Manager.
- The Radiation Protection Officer or his/her replacement should be available for contact during the scheduled cleaning.

- The Radiation Protection Officer should train a new cleaning staff member on how to properly clean a radioactive laboratory before he/she begins to work. The Radiation Protection Officer acquaints the new cleaner with the incident plan and any general guidelines for laboratory visitors.

IV 08 Work and safety instructions for uranium-containing materials

Although no Internal Permit is necessary for the possession and use of quantities less than 1,3 grams of depleted uranium in 2% solution, the SBE believes that sufficient attention should be paid to working with these materials, given the radiochemical properties and the chemical toxicity of uranium-containing materials. In addition, everyone who works with such materials must report this to the SBE using the **F06 Notification Form**.

Within the RUG, uranium-containing materials are used for certain fields, such as electron microscopy and X-ray diffraction. In these instances, in addition to depleted uranium (U-238), only the first radioactive decay products are present.

Activities and stocks above 1,3 gram in solution or UAc in powder form have to be used and stored in an isotope laboratory under an Internal Permit. In order to safeguard these materials, which formally are classified as fissionable materials (and therefore is considered to be a highly socially–sensitive issue), the SBE will not deviate from this policy unless there are major justifiable objections. The following methods and safety instructions should be used for working with uranium-containing materials:

Introduction
The toxic properties from both natural and depleted uranium are primarily determined for isotope uranium-238 (U-238). U-238 is at the beginning of a radioactive decay chain, where each decay product (except the stable end product) is also radioactive. During this chain, a large range of alpha, beta, and gamma particles are emitted. Alpha particles (helium nuclei) form an important part of the radiation from uranium. It is very easy to shield these particles (a few cm of air is sufficient), but if inhaled or swallowed, they can cause significant damage to bodily tissue. Inhalation of uranium-containing materials, for example when working with powders, must therefore be prevented as much as possible.

External irradiation of the body only occurs from beta (electrons) and gamma (photons) particles. The radiation exposure from external irradiation is in general minimal, however, unless one stays close (less than 1 meter) to an unshielded uranium source for a long period of time (a number hours per day). Shielding the source with approximately 1 cm of Plexiglas reduces the external radiation to nearly nothing. Shielding with lead is not advised due to the production of bremsstrahlung (and photons).

Work instructions
a. Preventing internal contamination
- Work in the hood.
- When working with uranium-containing materials in powder form, wear a mask and gloves.

b. Preventing external irradiation
- Shield the storage of the stock with at least 1 cm thick Plexiglas (or 1 mm of lead).
- Shield the working area also with 1 cm thick Plexiglas.

c. Administration and labeling
- Maintain a simple administration system with regards to the storage, use and purchase.
- Label stored stock and waste carefully.
- Use radioactive stickers (available at the SBE).

d. Waste
- Collect uranium-containing waste and contaminated materials in a separate container.
- Dispose the waste as radioactive waste (contact your Radiation Protection Officer or Radiation Commissioner).

e. Incidents/accidents
- Notify the Radiation Protection Officer in the event of incidents and accidents.

IV 09 Use of gloves in radionuclide laboratories

Based on practical experiences and the below mentioned risk analysis for working in a radionuclide laboratory, the SBE has prepared the following guideline for glove usage in radionuclide laboratories.

The dispersion of radioactivity during usage is not always avoidable (during pipetting, vortexing, etc). Furthermore, radioactive "hot spots" in a laboratory are not always known (therefore, wipe tests are always random). Despite careful handling by a researcher, such a contamination can not be ruled out. The chance that an unnoticed contamination occurs in this way within a radionuclide laboratory is so unpredictable that the risk of contamination to the bare hands should be prevented by wearing gloves. Based on the above reason, the following rules are set by the SBE:

1. Gloves should be worn on both hands when working in radionuclide laboratories where radioactivity is handled.

Constantly using gloves carries the risk that people may become careless towards the protection of others while trying to protect themselves, and people should be aware of this during proceedings outside of the work place. In addition to the above rules, the following rule also applies:

2. The use of tissues when handling objects outside of the work place should therefore be standard procedure. Assume that everything within the laboratory could be contaminated.

IV 10 Centrifuging and vortexing

Centrifuging and vortexing are manipulations that should take place in the fume hood. In practice, this is not always possible or desirable.

The SBE found during a investigation that, at the RUG, centrifuging outside of the hood could lead to a maximum effective dose of 50 µSv or a skin dose of 1 mSv. In addition, it was determined that centrifuging and vortexing caused less than 0,001% of the original radioactivity to be released. The risk of an internal contamination as a consequence of centrifuging or vortexing outside of the hood is therefore considered to be negligible.

On the above grounds, the following rules for centrifuging and vortexing are set by the SBE:

1. Centrifuging and vortexing should in principle always take place in the fume hood.

2. Centrifuging and vortexing outside of the hood is only allowed if the Radiation Protection Officer can justify why this cannot occur **inside** the hood. One of the following arguments may apply:
   - a centrifuge is too big to fit in the hood;
   - the working of a hood is adversely affected by the presence of a centrifuge, which could lead to an increased risk for the workers;
   - frequent centrifuging and vortexing yields a relatively large risk for dispersion of radioactivity within the laboratory due to constantly changing locations
   - the required speed of successive acts is too limited.

3. To determine the maximal manageable activity, the methodology from the appendix Radionuclide Laboratories should be used (also for determining activity for centrifuging and vortexing outside of the hood).

IV 11 Waste and discharge policies

This Internal Regulation describes when waste should be disposed of as radioactive waste and when as conventional waste, and also indicates when liquid waste may be discharged into the sewers.

In this Internal Regulation, the general criteria are given on the grounds of which the RUG determines how it disposes of radioactive materials that actually can be considered as waste. Furthermore, the relevant details are reported for almost all radionuclides that could be available within the RUG.

1. According to Article 3.20 of the Decree on basic safety standards radiation protection, waste is not considered to be radioactive if the concentration of activity of the material is lower than the clearance limit (in Bq/g) according to the table in appendix 3, part B, table 1 of the Decree on basic safety standards radiation protection or table A, part 1 of appendix 3.2 of the Regulation on basic safety standards radiation protection. Materials containing liquid have to be incinerated in an official waste incineration installation.

   If the waste consists of different types of radionuclides, the weighted sum of the activity should be calculated via the method given in Article 3.6 of the Ordinance on basic safety standards radiation protection. If the result of the summation is larger than 1, the waste is declared to be radioactive waste. If necessary, this can be checked by an estimation based on the composition of the nuclide mix.
   The weighted sum of the activity concentration of the in the handlings involved radionuclides is done according to this formula:

$$\sum_i \frac{C_i}{C_{v,i}}$$

   In which:
   C_i is the activity concentration of radionuclide in radioactive material (kBq/kg);
   $C_{v,i}$ is the applicable clearance levels of the involved nuclides i (kBq/kg).

2. According to article 3.16 of the Decree on basic safety standards radiation protection there is a possibility to clear a very small amount of radioactivity per year regardless of the activity concentration. This amount is so small than in practice this is not realistic and hence not implemented in this waste policy. If a radiation protection officer would like to use this possibility, he or she has to contact the radiationcommissioner and the radiation protection expert.

3. The release level to discharge radioactive materials into the sewer is set at 10 Re_{ing} per calendar year, calculated according to article 10.3 and calculated according to appendix 2 of the Decree on basic safety standards radiation protection. Because this criterion likewise does not apply to separate locations within the RUG, a release limit of 1 Re_{ing} per location is used, whereby the earlier mentioned activity concentration is used as an additional criterion. In this way, discharging of relatively large activity concentrations is prevented and, at the same time, the ALARA principle is satisfied. Be aware that in calculating Re_{ing} according to Appendix 2 of the Radiation Protection Decree, the correction factor for discharge is discounted (see the following page). The RUG does not discharge to surface water.

4. The criteria chosen above are outlined in **regulation SV04**. If the Radiation Protection Officer would like to use one of the other abovementioned criteria for radioactive waste and/or discharge, then he or she must ask permission from the Radiation Commissioner and General Coordinating Expert. Permission will be refused if, in their judgement, insufficient adherence to the ALARA principle is demonstrated or if a statutory provision is exceeded.

5. The used values for clearance levels, half time and corrections have to be based on the Degree on radiation protection (Table I). In this table all relevant data of the nuclides used within the University are described.

6. Radioactive material that it above the clearance level and can not be discarded on the sewer system has to be stored for disposal to the COVRA.

7. Specific clearance on the basis of Article 3.18 fourth and fifth paragraphs of the Basic Safety Standards for Radiation Protection Regulation (see below) is possible for solid waste. Counting vails with a small volume of liquid are considered as solid waste. Liquids, more than 1 liter, can not be cleared. These must be stored until further notice from the SBE.

Specifieke vrijgavewaarden voor verbranding, behorend bij artikel 3.18, vierde en vijfde lid

Specifieke vrijgavewaarden voor verbranding in een afvalverbrandingsinstallatie of bij ZAVIN te Dordrecht

Kunstmatige radionucliden	**Specifieke vrijgavewaarde bij verbranding in een afvalverbrandingsinstallatie niet zijnde ZAVIN te Dordrecht ($kBq.kg^{-1}$)**	**Specifieke vrijgavewaarde[1] bij verbranding bij ZAVIN te Dordrecht ($kBq.kg^{-1}$)**
H-3	4E+04	4E+04
C-14	4E+02	3E+02

De telpotjes vrijgegeven onder deze specifieke vrijgavewaarden dienen onder de volgende afvalstroomcode van de RUG afgevoerd te worden:

RU016 Telpotjes
Artikel: W.HW.C-001CI
Afvalstroomnummer: 01CH8Y073AD2

8. Specific release based on Article 3.18, second paragraph, of the Ordinance on Basic Safety Standards for Radiation Protection is not possible. Non-aqueous liquids with radioactivity (volumes greater than 1 liter) must not be released. These must be stored until further notice from the SBE.

Some examples on the clearance limits:

Clearance (generic) of counting vails H-3
Based on a counting efficiency of 20% (0.2 cps/dps) and an clearance of 100Bq/g for Tritium, a maximum of 20 cps/g = 1200 cpm/g may be measured in the counting vails. In the counting vails with 2ml (=2 gram) liquid, a maximum of 2x 1200 cpm = 2400 cpm may be measured. Counting vails above 2400 cpm can not be cleared and have to be stored for disposal to the COVRA.

Clearance (generic) of counting vails C-14
Based on a counting efficiency of 50% (0.5 cps/dps) and a clearance of 1Bq/g for Carbon a maximum of 0,5 cps/g = 30 cpm/g may be measured in the counting vails. In the counting vails with 2ml (=2 gram) liquid, a maximum of 2x 30 cpm = 60 cpm may be measured. Counting vails above 60 cpm can not be cleared and have to be stored for disposal to the COVRA.

Clearance (generic) of mice injected with H3
An average mouse weights 25 gram. At an clearance limit of 100Bq/g a maximum of 2500Bq can be injected to stay below the clearance level. A typical example of injection is 50.000Bq (50kBq) per mouse resulting in 2000Bq/g. These mice can not be cleared and have to be stored for disposal to the COVRA.

Clearance (specific) of counting vails H3
Assuming a counting efficiency of 20% (0.2 cps/dps) and a release value of 40,000 Bq/g for Tritium, this means that a maximum of 8,000 cps/g = 480,000 cpm/g may be measured in a counting vail. In a counting vail with 2 ml (= 2 grams) of liquid, a maximum of 2 x 480,000 cpm = 960,000 cpm may therefore be measured. Counting jars above 960,000 cpm may no longer be released and will have to be kept for transport to COVRA.

Table I. In this table the clearance levels, half-life values and correction factors are given in combination with the maximal discharge on the sewer system based on 1 Re_{ing} for all nuclides that are used within the university in 2017.

Table: clearance values for nuclides used within the university.

Nuclides	Clearance (Bq/g)*	Limit modest amounts (Bq/g)	Half-life	Correction factors		Maximal sewer discharge per year in GBq based on $1Re_{ing}$**
				Air	Water	
H3	100	1.000.000	12,4 year	1	1	24
C11	1000	10	20 minutes	1	0,001	41666
C14	1	10.000	5730 year	100	100	0,02
F18	10	10	2 hour	1	0,001	20408
Na22	0,1	10	2,6 year	1	1	0,31
P32	1.000	1000	14,3 days	1	0,1	4,17
P33	1.000	10.000	25 days	1	1	4,17
S35	100	10.000	87,5 days	1	1	7,14
Cl36	1	1.000	300.000 year	100	100	0,01
Ca45	100	1.000	165 days	1	1	1,32
Cr51	100	1000	27,7 days	1	1	26,31
Mn54	0,1	10	312 days	1	1	1,41
Co57	1	100	271 days	1	1	4,76
Fe59	1	10	44,5 days	1	1	0,56
Co60	0,1	10	5,27 year	1	1	0,29
Ni63	100	10.000	96 year	10	10	0,67
Zr89	100	10	78 hour	1	0,001	1282
Tc99m	100	100	6,02 hour	1	0,001	45454
In111	10	100	2,8 days	1	0,001	3448
I123	100	100	13,2 hour	1	0,001	4761
I125	100	1000	60 days	1	1	0,07
I129	0,01	100	1,6E+07 year	100	100	0,0001
I131	10	100	8,0 days	1	0,1	0,45
Cs137	0,1	10	30 year	10	10	0,007
Ra223	10	100	11,4 days	1	0,1	0, 10
Ac227	0,01	1	21,7 year	1	1	0,0009
U238sec	1		4,5E+09year	100	100	0,00001

*Based on: Table A part 1 of appendix 3, part B of the Bbs and table A, part 1, of appendix 3.2 of the Rbs.

**Per department, summed over the nuclides, a maximum of $1Re_{ing}$ aqueous solution can be discharged on the sewer system. Correction factors are discounted already.

IV 12 Granting an Internal Permit for the use of ionizing radiation at varying locations in the Netherlands

This regulation states how the SBE assesses a request for an Internal Permit that concerns the application of ionizing radiation at locations which are not explicitly named in the Complex Permit for Nuclear Energy Act and the accompanying applications and are not part of the area of one of the four entities.

The SBE uses the unabridged protocol **P01 Processing and assessing the application for an Internal Permit** to assess, in particular, whether any Secondary Level (as defined in the Annex to the Ministerial Regulation Impact Analysis of Ionizing Radiation) is exceeded. The requested Internal Permit is only granted if the applicant has demonstrated that at public accessible locations, the Secondary Level (10 μSv/year for external irradiation and 1 μSv/year for air and water discharges) is not exceeded.

If the application concerns a location of the RUG, it will be verified whether other entrepreneurs are established on the cadastral plot in question and - if this is the case - they have a permit or registration. If the latter is the case, the requested Internal Permit will only be granted if the total contributions to the dose at the site boundary of the applicant and the other entrepreneur do not exceed the Secondary Level.

If the Internal Permit is justified on the grounds of one of the new RUG application categories from Appendix I of the Ministerial Regulation Justification, the intended Internal Permit should be reported to the authority on Nuclear Safety and Radiation Protection. The granting of other Internal Permits to which this regulation applies is reported to the Decisions Department in the Annual Report

If the Secondary Level is exceeded, and the granting of an Internal Permit is nevertheless considered, prior consultation with the authority on nuclear Safety and Radiation Protection should occur and the intended Internal Permit should be presented to them for approval.

The Internal Permission for the use of ionizing radiation at other locations of the RUG and at varying locations in the Netherlands explicitly states the location to which it applies. Compliance with regulation **SV19 The application of ionizing radiation at other locations of the RUG and at varying locations** in the Netherlands is linked to the Internal Consent.

If the Internal Permission relates to other locations of the RUG, the SBE will provide a cadastral plot of the plot of land on which the application takes place. The boundaries of this cadastral plot are considered the site boundary.

IV 13 Highly active sources (HASS) and safeguarding radioactive materials

For every request for (change of) an Internal Permit to work with encapsulated or sealed sources and/or to work with radioactive materials in dispersible form, the SBE assesses if the specific regulations for highly active sources and/or the safeguarding of radioactive materials are applicable or will be applicable.

Safeguarding of radioactive materials
If the regulations regarding the safeguarding of radioactive materials apply, the current Security Plan for Radioactive Materials of the RUG is reviewed under the coordination of the General Coordinating Expert who has been designated as responsible person for the security by the board of the University. Before the (change of) Internal Permit can be granted, it should be verified that these specific regulations and the provisions in the Security Plan are met.

High Activity Sealed Sources (HASS)
In general, it can be stated that, if the regulation for the safeguarding of radioactive materials is applicable for an encapsulated source, the regulation for highly active sources is also applicable.

The SBE ensures the appointment of a security responsible and that the mandatory coding, financial security, emergency plan and periodic reports to the government which are required by the regulation for highly active sources, are performed.

Radiation Protection Officers of highly active sources and who also fall under the regulation for safeguarding radioactive materials should have sufficient knowledge to carry out their applicable portion of the Security Plan for Radioactive Materials. The SBE sets written instructions, if necessary, for Radiation Protection Officers who are responsible for other highly active sources.

Radiation Protection Officers who are responsible for highly active sources should be trained at least once per two years on the security aspects of these sources. If possible, this training should be combined with the periodic inspection visit. The training given is then reported in the Inspection Report. Users of the HASS also receive updated instructions once per two years.

IV 14 Continuing education of Radiation Protection Officers

Education
A person who is required to follow adequate training for Radiation Protection Officer follows a specific training course to become a 'Radiation Protection Officer' (TS). To this end, nine different partial applications have been defined in the Regulation on basic safety standards for radiation protection (art. 5.22), six of which are relevant to the RUG. The following applications are involved:

1. Medical applications (MA, MT)
2. Dental Radiation (DR, THK) - two levels
3. Veterinary medicine (VM, VET)
4. Nuclear Fuel cycle (NFC, SPL) - two levels
5. Dispersible Radioactive Material (DRM, VRS) - three levels
6. Naturally Occurring Radioactive Material (NORM)
7. Accelerators (Acc, VER) - three levels
8. Industrial radiography (IR)
9. Measurement and control applications (MC-S, MR-B) Sources
10. Measurement and control applications (MC-D, MR-T) Devices

For each of these application areas, there are training courses on TS, for VRS and Accelerators on three levels, for THK on two levels and for the rest on one level.

In addition, old training courses up to radiation expert levels 3, 4 and 5 are also permitted for supervisors. These are best in line with the permit requirements of the current KEW complex permit:

- Radionuclide laboratory: Radiation expert level C diploma, level 3 or coordinating expert.
- Encapsulated sources with moderate risk: Radiation Expert Level D diploma, Level 4A or 4B.
- Moderate risk devices: Radiation expert level 4A diploma.
- Ten or more sealed low-risk sources: Radiation Expert Level 4A or 4B diploma.
- Ten or more low-risk devices: Radiation expert level 4A diploma.
- Less than ten low-risk sealed sources: Radiation Expert Level 5A or 5B diploma.
- Less than 10 low-risk devices: Radiation expert level 5A diploma.

In view of the above and
- the fact that the TS-VET training is intended for veterinary medicine and not for animal studies, and is therefore not relevant for UG supervisors;
- The fact that TS-NORM is intended for industries where naturally present radioactive substances may be present as undesirable by-products, while the applications present at the RUG are used in the context of research, education or demonstrations and are therefore not relevant to the RUG either;
- The fact that the applications of uranium and thorium-containing substances present at the RUG are primarily used for research, education or demonstrations because of their radioactive properties, which makes TS VRS-D, rather than TS-NORM, appropriate;
- the training of radiation expert level 3 (3), coordinating expert (CD), radiation protection expert at the level of coordinating expert (CD) or higher is sufficient for each supervisor

the SBE applies the following training requirements for radiation protection supervisors

Application	Minimal education level	Remark
Radionuclide laboratorium	3, CD, SBD-CD, TS VRS-B	
Encapsulated and sealed sources with high risk	3, CD, SBD-CD	This includes High Activity Sealed Sources and alignment activities with Rontgen diffraction equipment
Accelerators	3, CD, SBD-CD, Ver-B	
Encapsulated and selaed sources with medium risk	4A, 4B	There is no equivalent TS training for this - based on the RI&E, the SBE may consider using TS-MR, TS-MR-B or TS VRS-D as sufficient.
Cone-Beam CT-equipment for dental radiology	4A, 4AM, TS-THK (level CBCT)	
Other equipment with moderate risk	4A	There is no equivalent TS training for this - based on the RI&E, the SBE may consider using TS-MR, TS MR-T as sufficient.
Ten or more encapsulated or sealed sources of low risk	4A, 4B	See remark for moderate risk sources
Ten or more instruments for dental radiology	4A, 4AM, TS-THK (level CBCT)	Independent of the risk of the instrument
Ten or more instruments with low risk	4A	See remark for moderate risk instruments
Less than ten encapsulated or sealed sources with low risk	5A, 5B, TS MR, TS MR-B, TS VRS-D	
Less than ten instruments for dental radiology with low risk	5A, 5AM, TS THK (basis)	
Less than ten instuments with low risk	5A, TS MR, TS MR-T	

Continuing education and training
The Decree on basic safety standards for radiation protection obliges the entrepreneur to adequately train radiation protection officers in the field of radiation protection. In this regulation, the SBE describes the way in which this is implemented at the University of Groningen.

A Radiation Protection Officers is considered to be adequately trained if he or she is registered by the government in the register of radiation protection experts as referred to in Section 5.5 of the Decree on Basic Safety Standards for Radiation Protection.

For the other Radiation Protection Supervisors, the SBE will, as far as possible, follow the methodology used by the government to register radiation protection experts, on the understanding that
- a level 3 expert, CD / SBD-CD, who visits the SBE refresher courses every year and is a member of the NVS, has almost fulfilled his after- and in-service training requirement;
- During inspection visits, the SBE assesses the extent to which a Radiation Protection Supervisor meets the requirement for adequate further training and, if necessary, makes agreements about the way in which this can be met;
- the first assessment takes place within five years of the appointment of the Radiation Protection Supervisor;
- a Radiation Protection Supervisor administers any evidence of participation in continuing and further training at RADMIN.
- The SBE can oblige a Radiation Protection Supervisor to take part in specific refresher courses aimed at the application, regardless of the foregoing;

The SBE therefore uses the following scheme as a general starting point for the continuing and further training requirement for radiation protection supervisors

The SBE uses the following scheme as general guide for continuing education for Radiation Protection Officers.

Required level	**Points to accumulate in five years**
3, CD, SBD-CD, TS VRS-B, TS Ver-B	40
4A, 4AM, 4B, TS THK-CBCT	20
5A, 5AM, 5B, TS MR, TS MR-B, TS MR-T, TS VRS-D, TS THK-basis	10

The SBE values continuing education activities and, in principle, is in accordance with the schedule established by the government. However, differences in training are outlined here below:

Activity	**Accreditation**
Refresher course without exams	5 pt per half day session
Refresher course with passed exams/tests	7,5 pt per half day session
Congress or symposium visit	2,5 pt per half day session
Lecture / presentation / poster	10 pt
Publication in journal	5 pt
Publication in peer reviewed journal	10 pt
Teaching at a recognized institution	2 pt per lesson hour
Membership of a professional association (i.e. NVS)	2 pt per year
Membership in an (inter)national or local committee	10 pt per commission per year

IV 15 Instructions Exposed Workers

During your work you may be exposed to ionising radiation. It is important for your own health and that of your colleagues that these activities are carried out safely. Within the RUG, the radiation protection unit (SBE) takes care of the organisation of working safely with ionising radiation. For your work, you are trained and classified as an 'exposed worker category B'. There are instructions in place in daily practice to guarantee safety. If you follow these instructions, you and your colleagues will at most only receive low doses of radiation. For clarity, we have summarized the most important rules below.

- You will receive further instructions from the local supervisor prior to your work as an exposed worker. In these, he or she will in any case - where relevant - pay attention to
    - o where you may/must carry out your work;
    - o the use of dose rate and/or contamination monitors;
    - o shielding measures;
    - o personal protective equipment (clothing / gloves / safety glasses, etc.);
    - o the avoidance of the dispersion of radioactive substances;
    - o how to deal with (radioactive) waste.
- You will follow the instructions of the local supervisor and the instructions given by him or her.
- In the event of a (possible) incident, accident or other irregularity, you immediately warn the local supervisor. Take note of the rules for 'first aid in the event of an emergency' (see next page).
- Via the local supervisor, you will receive a personal dose control device, the 'TLD badge'. This badge is personal. You may not lend the badge or wear another person's badge.
- During your work as an exposed worker, you wear your badge visibly on the outside of your clothing (preferably at chest height).
- If you are pregnant, you are kindly asked to report this to the local supervisor so that he/she can assess whether and to what extent it is possible to continue working with ionising radiation during pregnancy.

If you want to know more about radiation protection within the RUG, or if you have questions about (the risks of) your exposure, it is good to know the following:

- A risk inventory and evaluation (RI&E) has been drawn up for your work. Attention has been paid to keeping your exposure to ionising radiation as low as possible. In general, your exposure will be low to very low. You can always ask the local supervisor for an explanation of the RI&E.
- For questions about your health in relation to exposure to ionising radiation, you can contact the Radiation Protection Unit via the secretariat of the Health and Safety Department (amd@rug.nl, tel. 3635551). For specific questions, the RUG has a contract with the radiation physician.
- If you would like to contact the radiation physician directly, please contact Dr F.H.W. Jungbauer, tel. 06 285 59450, f.jungbauer@kpnplanet.nl.
- Would you like to know more about radiation protection within the RUG? On this webpage you can find all relevant information.

Life-threatening situations and emergencies: Emergency number RUG 8050

First aid in the event of an emergency:

- At internal contamination: spit out immediately, blow your nose, vomit or cough and rinse the mouth – collect material for dosimetry
- At external contamination: remove contaminated clothing (don't throw away) and rinse and wash contaminated spot with water – collect wash water for dosimetry
- At external irradiation: shut off the equipment immediately or take large distance from source.
- At laboratory contamination: prevent further spreading by notifying other people present, evacuate and mark the involved spot.

At all incidents and unwanted events, also loss of a source or sewage or air discharge of a large amount of activity:
Always inform the Local Radiation Officer and/or Radiation Commissioner.

3 General regulations

AV 01 Request for an Internal Permit

An Internal Permit should be requested using the form **Request for an Internal Permit.**

The procedure **P01 Processing and assessing the application for an Internal Permit** explains how an application is processed. An application is not admissible if it has not been approved by the Radiation Commissioner from the appropriate entity.

The application form and any appendices form the basis for the **Digital KEW File** which should be administered digitally in RADMIN.

The Radiation Protection Officer is responsible for keeping the Internal Permit up to date.

AV 02 Change or extension of an Internal Permit

Formal changing an Internal Permit

A change in an Internal Permit should be requested by using the form F02 **Change in an Internal Permit**. This form should be completed for a proposed alteration or extension of the application, for which an Internal Permit has already been given, and where the risks for the particular application change and an adjustment to the risk analysis occurs. In addition to the change form, questions on the form F01 **Application for an Internal Permit** where the answers have changed should be again completed with the new information.

Extension of an Internal Permit

Extension of an Internal Permit, which has been granted initially for a certain period, can be requested using the form F04 **Extension of an Internal Permit.** This form should be submitted to the SBE well before the expiration date of the Internal Permit.

The processing is carried out according to the procedure **P01 Processing of an Application for an Internal Permit**. The application for changing or extending an Internal Permit is not admissible if it has not been approved by the Radiation Commissioner from the appropriate entity.

Administrative change in a written Internal Permit

An administrative change in an Internal Permit is possible if there is an expansion or reduction in the scope of the Internal Permit which does not have any consequences for the personal exposure, emissions to the environment and the applicable risk analysis for the Internal Permit (for example, replacement of a device with a similar device, or adding a calibration source). The choice of whether to request a formal or administrative change should be discussed with the General Coordinating Radiation Expert beforehand. For an administrative change, it is sufficient to submit an appendix to the written Internal Permit.

AV 03 Withdrawal of an Internal Permit

If the application for which an Internal Permit has been given has come to an end, then a request to withdraw the Internal Permit should be submitted within two years. The form **F03 Withdrawal of an Internal Permit** should be completed and submitted.

This form will be processed according to the procedure **P01 Processing of an Application for an Internal Permit.** The request to withdraw an Internal Permit is not admissible if it has not been approved by the Radiation Commissioner from the appropriate entity.

All conditions stated in the Internal Permit stay valid until the withdrawal of the authorization.

AV 04 Local (Digital) Nuclear Energy Act (KEW) file

A local KEW file should be present for nearly every application involving radioactive materials, sources or ionizing radiation-emitting device for which an Internal Permit is granted. The KEW file consists of a general file supplemented with application-specific parts. The general file consists of the following digital documents stored on the Y-drive (RADMIN):

Local Digital KEW file
- Internal Permit plus any supplementary documents and changes
- Application for an Internal Permit with appendices and any change requests
- Diploma of the Radiation Protection Officer
- Appointment letter for the Radiation Protection Officer
- Miscellaneous official correspondence

The required supplementary information for this general file is summarized in the regulations of the particular application. For the sake of clarity, the additional information arising from the general regulations are listed below:

Application file
- Current risk analysis
- Incident plan
- Reports of inspection visits (audits)
- Reports of any missing materials, accidents and disasters
- Overview of the exposed workers and their classification categories
- Administration records for TLD results
- Overview of the emissions to the environment
- Overview of the present radiation monitors and portable dose meters
- Reports of the inspection of the radiation monitors
- Notation of the replacement person for the Radiation Protection Officer
- A map of the room(s) where ionizing radiation is used

This information should be present in every Local KEW File. The Radiation Protection Officer is responsible for keeping the KEW files up to date and in order.

All documents should be kept for at least five years.

The local KEW file is kept in digital form. Digital documents are located within the dedicated Y-disk structure (RADMIN).

AV 05 Expertise and training requirements

Anyone managing, using or working with radioactive substances, sources or devices emitting ionising radiation must be competent. A diploma of appropriate training as a Radiation Protection Officer, training as a Coordinating Radiation Protection Expert, or equivalent expertise is required for those working as supervisor, and for those classified as exposed workers (see **AV06 Exposed Workers Category Classification**).

Supervisors
Internal Regulation **IV 14 Continuing education of Radiation Protection Officers** provides the necessary training for supervisors. The training and education levels for supervisors are described in the Basic Safety Standards Regulation, Article 5.22. In the RUG Handbook Radiation Hygiene, the diploma of such training is also referred to as Diploma Ionising Radiation.

Every Radiation Protection Supervisor must undergo sufficient refresher and further training. The SBE uses the guidelines mentioned in Internal Regulation IV14 for this.

Exposed employees
In the absence of an appropriate Ionizing Radiation diploma, the Radiation Protection Supervisor, together with the Radiation Commissioner of the entity to which the application falls, assesses whether the exposed worker has sufficient expertise and is authorized to carry out practices or work with radioactive substances, fissile materials and ores or the operation of ionizing radiation emitting devices. Information about the radiation safety courses organized by the Groningen Academy for Radiation Protection can be found on the RUG website.

As appropriate training for exposed workers is considered:

Nature of application	*Minimal course*
Dispersible radioactive material or possibly activated material	TS VRS-D / 5B
Sealed sources	TS VRS-D / TS MR / TS MR-B / 5B of 5A
Appliances	TS MR / TS MR-T / 5A

Required additions to the **Local KEW File**:
- Diploma Radiation Protection Officer
- Proof of continuing education for the Radiation Protection Officer

AV 06 Category classification of exposed workers

Anyone, who for occupational reasons or who works with radioactive materials or ionizing radiation-emitting devices as part of a study program, is considered, in principle, to be an exposed worker. Depending on the application and the nature of the work, the worker will be classified in Category A or B.

Exposed workers are divided into two categories, i.e. category A and B.

- A-workers are those to whom the criteria below applies:
  - The person is likely to receive a total effective dose of more than 6 mSv per year due to external irradiation and internal contamination, or
  - There is a chance that the individual will receive an equivalent dose of more than 15 mSv per year on the lens of the eye or 150 mSv per year on the skin or extremities.
- B-workers are persons to whom the criteria below applies and who, moreover, do not fall under category A-employees:
  - There is a chance that the persons concerned will receive an effective dose of more than 1 mSv per year, or
  - There is a chance that the individual will receive an equivalent dose of more than 50 mSv per year on the skin or extremities.

The Radiation Protection Officer who oversees an application decides, together with the Radiation Commissioner of the entity under which the application occurs and, if necessary, after consultation with the Radiation Physician and a Central Expert, if someone is an exposed worker and under which category the exposed workers should be classified. In the procedure **P02 Classification of Exposed Workers**, the category classification is discussed in detail. Review of the dose meter readings can be used to determine the category. If all exposed workers are classified as category B workers, an explicit inclusion of the category classification in the file may be omitted. A radiological worker should be registered at the Health, Safety and Environment Service by the Radiation Protection Officer or under his/her supervision.

Category A workers should be examined by the Radiation Physician before beginning work and yearly thereafter. Exposed workers who are classified in Category B fall under the regular occupational health care system.

Exposed workers must always wear a personal control device while performing radiological work. The rules regarding this are given in the regulation **AV07 Personal Control Devices**.

If the employee is a UMCG employee who is also exposed to ionizing radiation at the UMCG (irrespective of whether he/she is classified as an exposed employee at the UMCG), the procedure will be in accordance with **Procedure P 04**.

Required additions to the **Digital KEW File**:

- Overview of exposed workers and their category classification

AV 07 Personal Control Devices

To detect radioactivity during radiological work, a hand monitor should be used. An electronic personal dose meter or a pen dose meter could also be used to measure the radiation dose accrued during the work (see the regulation **AV12 Radiation monitoring**).

All exposed workers should wear a personal control device during their radiological work which measures the radiation dose received during the proceedings. The Radiation Protection Officer, together with the Radiation Commissioner of the entity within which the application takes place, decides which method of personal dose monitoring is necessary in a certain case.

The RUG uses thermoluminiscence dose meters (TLDs) which are made up by name for each worker. Every four weeks, the Radiation Protection Officer, who is responsible for the application under which the exposed worker falls, changes the TLDs for a new one. The TLDs are then read by Mirion Technologies. The Radiation Protection Officer has access to the Mirion Portal for the meter readings. The data shall be available upon request to exposed employees carrying a TLD. Attention is paid to dose results that deviate from the standard pattern in relation to the expected RI&E values.

When a TLD is not suitable for dosimetry (for example, during the use of ^{3}H, ^{14}C or ^{35}S), the Radiation Protection Officer (and, if necessary, in consultation with the Radiation Commissioner and the Radiation Physician) should find an alternative dosimetry method to use. Exemption from the requirement for exposed workers to wear a TLD in this case can only be granted by the government.

Monitoring dose result:
For RUG employees, an alarm level on the badge result (dose) of 50% of the dose limit applies. If an RI&E shows that this alarm level can be exceeded, a further analysis is carried out. This further analysis may show that exposure beyond the dose limit is unavoidable, but justified.

- For employees who are not classified as exposed, a dose limit of 1 mSv per year with an alarm level of 0.5 mSv applies.
- For employees who are classified as exposed employee B, a dose constrain of 6 mSv per year with an alarm level of 3 mSv applies.
- For employees who are classified as exposed employee A, a dose limit of 20 mSv per year with an alarm level of 10 mSv applies.

Check of badge results exposed employees:
Badge results of exposed employees are checked monthly. With an incurred monthly dose higher than 0.3 mSv (roughly 1/12 of the alarm level of a B-worker), the relevant badge holder is informed via the local supervisor and the reason for the incurred dose is investigated. Where possible, adjustments are made to reduce the dose to be incurred.

AV 08 Missing, Accidents and Incidents

For every application using radioactive materials, sources or ionizing radiation-emitting devices, a written incident plan should be present. In this plan, the measures to be taken to prevent further contamination and/or exposure of people during a radiation incident are stated.

Exposed workers should inform the Radiation Protection Officer in the event of accidents, incidents, or a missing radioactive material, open or sealed source or ionizing radiation-emitting device. The Radiation Protection Officer should immediately notify the Radiation Commissioner of the entity and the General Coordinating Radiation Expert. The incident plan lists the contact details of them. A written report about the missing material/device, the accident or the disaster should be included in the KEW file. A copy of this report should be (digitally) available for the Radiation Commissioner of the entity and the General Coordinating Radiation Expert.

Required additions to the **Digital KEW File**:
- Incident plan.
- Reports of any missing materials/devices, accidents or disasters.

AV 09 Radiological areas

Definition: a radiological area is an area where
- open or sealed radioactive sources are used, and/or
- open or sealed radioactive sources are stored, and/or
- radioactive waste is stored, and/or
- a device that emits ionizing radiation is installed.

Operations and activities with radioactive materials should be limited to the radiological area(s) reported in the **Internal Permit**.

- Zoning: This follows in principle from the evaluation of the risks written down in the RI&E. Within the RUG, the following minimum requirements apply to zoning:.

  Open sources:
  C- and D-laboratories: all areas are in principle supervised zones
  B-laboratories are controlled zones

  Sealed and encapsulated sources:
  Areas with a significant risk of theft shall at least be supervised areas. Otherwise, zoning shall be determined in accordance with the risk assessment.

  Devices:
  no zoning except at accelerators and 'open' X-ray apparatus, which, depending on the nature of the application, can be set as guarded or controlled zones.

  Warning signs, exclusively:
  on all individual sources of ionizing radiation, and
  on/near all access doors to guarded or controlled zones.

- A radiological area or a contiguous group of such areas should be lockable.

- If there is no work being performed in the radiological area or contiguous group of such areas, the access doors should be locked. Under normal circumstances, the doors should be closed.

- A radiological area or a contiguous group of such areas should offer sufficient shielding such that the dose equivalent rate outside of the area, but within the building in which the are is located less than 1 mSv per year or 0.5 µSv per hour, with a occupation of 2000 hours annually.

The **Specific Regulations** contain additional demands on the building construction and design of the radiological areas for certain applications. The requirements for the storage area for radioactive materials and sources are given in the regulation **SV02 Storage of Radioactive Materials and Sources**.

AV 10 Internal Permit inspections

At least once per year, an inspection of the Internal Permit should occur. The SBE will initiate the inspection process. The inspection is carried out on the basis of a list of points of interest as shown in the form **F06 Inspection Report** (and in the procedure **P03 Inspection of Internal Permits**). The results of the inspection are reported together with any agreements made and action item(s) to be carried out. Shortcomings or situations that are not in accord with the Internal Permit will not be tolerated and must be resolved within a fixed period of time.

The regular inspection is performed by the General Coordinating Radiation Expert together with a Radiation Commissioner from an entity other than the one in which the location is a part. The Radiation Protection Officer should also be present during the inspection. Deviation of the above mentioned is possible during other inspections.

The inspection report should be included in the Local KEW File.

Required additions to the **Digital KEW File**:
- inspection reports.

AV 11 Notification

Annually, before the 15th of February, an overview of the sources list, including the purchase and use of, waste figures and the emissions to the environment from the previous calendar year as a result of the application, should be given to the SBE. If the emissions in the new calendar year are expected to deviate from the previous year, this should be indicated. The SBE can request additional data when necessary. The Radiation Protection Officer is responsible for providing this information. The data will be included in the annual report of the SBE.

Definition: Emissions to the environment are all the discharges of radioactivity materials to water and air, and the effective dose per year within the grounds of the RUG as a consequence of radioactive open and sealed sources and devices that emit ionizing radiation within the RUG grounds.

- Emissions to the environment should be as low as reasonably achievable (ALARA).
- The emissions to the environment, if they happen, should be calculated in the manner described in Appendix 10, of art. 4.37-4.39 of the Vbs. The calculation for the external exposure dose (MED) because of X-ray devices should be identical to that for radioactive open and sealed, on the understanding that the factor $A.\Gamma.O$ should be replaced by Γ, the dose rate at 1 m from the focus in $\mu Sv.m^2/h$. The provision relating to the method of calculation of MED does not apply to devices described in the regulation **SV13 Accelerators**.
- The calculation of the maximal theoretical discharge in water (MLV), discharge in air (MLL) and the MED forms a part of the form **F01 Request for an Internal Permit**. The calculations for a new application should be based on the expected purchase data.
- The MLW and MLL should fall below the appropriate assessment levels, such as those given in Appendix 10, of art. 4.37-4.39 of the Vbs .
- The overview of emissions should be included in the Local KEW File.

Required additions to the **Digital KEW File**:
- overview of the emissions to the environment.

AV 12 Radiation monitors

In all supervised and controlled areas, and for survey measurements, an adequate radiation monitor should be present.

In the **Digital KEW File** of each Internal Permit, an overview of the available radiation monitors and portable dose monitors (such as an electric personal dose meter) should be present in which the type and range is given.

Radiation monitors should be checked yearly. The data from these checks should be included in the **Digital KEW File**. If a radiation monitor is not functioning properly, the Radiation Protection Officer should ensure the repair or replacement of the monitor.

Further provisions relating to contamination control and leakage testing are listed in the special provisions.

Required additions to the **Digital KEW File**:
- Overview of the present radiation monitors and portable dose meters.
- Reports of the inspections of the radiation monitors.

AV 13 Replacement of the Radiation Protection Officer

If the Radiation Protection Officer is not accessible due to any circumstances, he/she should ensure that there is a suitable person that is acquainted with the application(s) to take his/her place.

The required expertise level of the replacement is the same as the minimum requirements set for a Radiation Protection Officer.

The Radiation Protection Officer designates a (preferably fixed) replacement in writing. A copy of the appointment is signed by both the replacement and the Radiation Protection Officer and is placed in the **Digital KEW file**.

Arranging a replacement is not necessary if:
- The application is not used when the Radiation Protection Officer is absent and the radiological areas are locked.
- The Radiation Protection Officer finds it reasonable that from a radiation safety standpoint, replacement is meaningless.

Procedures should not be performed without expert supervision.

Required additions to the **Digital KEW File**:
- Appointment of replacement.

AV 14 Transfer of sources to third parties

The transfer of sources (i.e. open radioactive materials, encapsulated/sealed sources, fissionable materials/ores or devices) to third parties should only take place with the approval of the Radiation Protection Officer after consultation with the SBE.

The recipient of the source must have an adequate Nuclear Energy Act permit. If it is unclear whether this is the case, transfer is forbidden.

- For transfers to another group within the RUG, the recipient should possess an adequate Internal Permit. If this is not the case, then the transfer is not allowed.

- To transfer radioactive waste to COVRA, the regulation **SV 04 Waste and Discharges** applies.

The regulation **SV 03 Transport of Radioactive Materials and Sources** applies to all transport of sources, with the exception of devices.

Required additions to the **Digital KEW File**:
- Copy of the KEW permit of the recipient of the source (only necessary if the transfer to a third party outside of the RUG occurs via the Radiation Protection Officer himself);
- Proof of transfer of the source.

4 Special Regulations

SV 01 Purchase of Radioactive Materials and Sources

The purchase of radioactive materials and sources should be accomplished by or under the direction of the Radiation Protection Officer. This may only occur if the order falls within the scope of the Internal Permit. The standing orders should be maintained in the records of the location.

The radioactivity should be received by the Radiation Protection Officer as soon as possible after delivery and transported to the appropriate location. The shipment should be checked for radioactive contamination of the packaging.

If radioactive materials have been purchased without the knowledge of the Radiation Protection Officer, then this should be reported to the Radiation Commission, who, in consultation with the General Coordinating Expert, will make a decision on any follow-up actions.

Return packaging should be free of radioactive contamination when it leaves the radionuclide laboratory and all warning labels for radioactive materials or sources should be removed.

The Radiation Protection Officer can use the internal regulation **IV 06 Ordering and Receiving of Radioactive Materials and Sources** to implement the above procedure.

Required additions to the **Digital KEW File**:
- Records of the orders placed.
- Ordering and delivery procedure
- Record of responsible persons for orders and order collection

SV 02 Storage of radioactive materials and sources

Radioactive materials and sources which are not in a radiation position[4] or part of a stock should be stored in a storage unit that fulfills the requirements set forth in art 4.8 of the Vbs. The following regulations apply for storage units:

- The construction of the storage unit must be such that at 10 cm distance from any point of the surface, the dose equivalent rate is less than 1 μSv/h. This should be checked at least once per year.

- The construction of the storage unit must be fire-resistant for 1 hour.

- The storage unit must be equipped with a warning sign for radioactive materials and the words "RADIOACTIVE MATERIALS".

- The storage unit must be lockable and may only be opened by the responsible Radiation Protection Officer and people appointed by him.

- A simple, movable storage unit should be placed in a lockable cabinet, which can only be opened by the responsible Radiation Protection Officer or people appointed by him.

- A storage unit must be able to be decontaminated, if necessary.

- An accessible storage unit should be ventilated three times per hour.

- The storage location is demonstrably known to the Safety Region.

- Storage of liquids only takes place in proper containers and above an adequate facility for leaked liquids.

Required additions to the **Digital KEW File**:
- Records of periodic dose rate measurements.

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[4]"Radiation position" means the radioactive source or material is used under normal circumstances.

SV 03 Transport of Radioactive Materials and Sources

The transport of radioactive materials and sources from RUG locations over public roads should occur following the rules set out in the VLG-ADR legislation. The NVS publication nr. 32 “The transport of radioactive materials over public roads in Nederland” should be used as a manual for this purpose. The central transport service of the RUG is the only RUG-designated service to perform this transport. The sender is responsible for ensuring safety during transport.

To transport radioactive materials and sources within university buildings or grounds, the packaging should be such that there is no danger of irradiating people and the environment. The packaging must have a warning sign for radioactivity and a label containing the nuclide and the activity. This requirement does not apply for exempt goods. Such transport should be carried out by or under the responsibility of the Radiation Protection Officer of the sender. The package should never be left unattended and should be checked for contamination upon delivery by the receiving party.

If a fixed route for internal transport is mandated (to a certain department or storage place), then these should be set in the instructions. This route should be prepared such that the interaction between the transport and the flow of people within the building is limited as much as possible (preferably using cellars and service elevators).

Required additions to the **Digital KEW File**:
- Internal transport protocol

SV 04 Waste and discharges

Definition: Radioactive waste is waste in which the activity concentration (in Bq/g) is higher than the clearance limit for the specific nuclide[5] . If the waste consists of different types of radionuclides, the weighted sum should be calculated using the method outlined in article 3.6 member 2 of the Ordinances on basic safety standards radiation protection. If the result of the summation is larger than 1, the waste is labeled as radioactive waste.

Disposal of waste

The following rules apply to the clearance of waste:

Solid waste, liquid organic waste and cadavers:

- Waste with an activity concentration lower than the clearance value for the specific nuclide can be disposed of, depending of the nature of the waste, as hazardous waste or as general commercial waste, by or under the authority of the Radiation Protection Officer.
- To prevent any anxiety on the part of the disposal company, the released waste must have a dose rate on the outside of the packaging which is less than 0.5 μSv/hour, and must not have any recognizable radioactive stickers on it. Please note: if the dose rate on the outside of the packaging is measurable, it is possible that a detector might signal at the disposal company. It is therefore very important to be absolutely sure that the clearance value is not exceeded! To ensure that the clearance limits are not exceeded, a safety margin of at least a factor of 2 should be used when determining or estimating the activity concentration.
- Upon request from the disposal company, all desired information about the radioactivity in the clearance waste should be given.

Aqueous waste:

- Aqueous waste that does not have to be labeled as chemical waste can be discharged into the sewer provided that the released activity in one calendar year is less than 1 Re_{ing}, as calculated according to Appendix 2 of the Decree on basic safety standards radiation protection. The discharge can occur by or under the authority of the Radiation Protection Officer. Radioactive materials may not be released to surface water.

Counting vails

- Counting vails that are above the clearance limit (see **IV11 Waste**) must be kept separately from counting vails that are below the clearance limit. Counting vails below the generic release limit can be disposed of as chemical waste. Counting vails that are below the specific release limit can be disposed of as chemical counting vails waste. Counting vails with an activity above the specific release value must be taken to COVRA.

General:

- The release or discharge of (short-lived) radioactive waste follows the ALARA principle.
- The Radiation Protection Officer should register the activity (per nuclide in Bq and Re_{ing}), and record these in the Digital KEW File. Whenever possible, this should occur before the waste containing radionuclide waste is transported
- Determining the activity concentration occurs by liquid scintillation counting of fluid waste which only consists of β-emitters and by an appropriate alternative method by other liquid waste. For solid waste, the Radiation Protection Officer makes a conservative estimate. *Consider a safety margin of a factor of 2 when determining or estimating the activity concentration.*

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[5]See table in Internal Regulation IV11 **Waste and discharge policy**

Radioactive waste

Radioactive waste can be classified into two categories: short lived and long lived. The border between short- and long-lived wastes is a half-life of 100 days. Long-lived radioactive waste, as well as short-lived radioactive waste which cannot be released or discharged within 2 years, should be disposed of as fast as reasonably possible by COVRA (Article 10.7 member 4 of the Decree basic safety standards radiation protection).

In so far as it doesn't conflict with the above-mentioned rules, the handling and disposal of radioactive waste should be performed following Chapter 9 of the Guideline for Radionuclide Laboratories[6]. The **Digital KEW File** should contain, amongst others, the following information:

a. Records of the following should be kept up to date:
   - the time of placement and disposal of the container,
   - if possible, the activity per nucleotide in the container, and
   - the origin and destination of the container.
b. The waste plan should describe the manner in which the waste is removed from the storage place and disposed of.

The Radiation Protection Officer oversees the removal and disposal of the waste from the waste storage facility. The regulation **Transport of Radioactive Materials and Sources** describes the method of transport. The storage facility is a radiological area and should fulfill the requirements stated in the regulation **Radiological Areas**. The storage facility must be fire resistant for at least 1 hour.

Required additions to the **Digital KEW File**:
- Waste plan
- Waste container records
- Records of discharged or released radioactivity

[6] Guideline for Radionuclide Laboratories, VROM publication 94-02

SV 05 Sealed radioactive sources and closed sources according to RUG specifications

Definition: a **sealed radioactive source** is a source of ionizing radiation which is formed by radioactive materials that are imbedded in or permanently attached to a non-radioactive carrier material, or are surrounded or encapsulated in a housing of non-radioactive material. The carrier material or housing offers sufficient resistance to prevent any dispersion of the radioactive materials from the source under normal circumstances.

In the law, sealed sources are defined as: a radioactive source of which the radioactive material is permanently encapsuled in a capsule or bound to a solid form preventing dispersion under normal use.

A sealed radioactive source should fulfill all the requirements stated in the art. 4.9, 4.10 and 4.11 of the Vbs. This means the following:

- The sealing of the source must comply with the requirements stated in the ISO2919/2012 standard or an equivalent standard.

- The source holder should be equipped with a clearly visible warning label for radioactivity.

- If the source is mounted in an apparatus, then the apparatus must also be equipped with a clearly visible warning label for radioactivity.

Definition: a **sealed source according to RUG specifications**, called a sealed source from now on, is a source of ionizing radiation that is formed by radioactive materials imbedded in or permanently attached to non-radioactive carrier materials, or are surrounded or encapsulated in a housing of non-radioactive material. The carrier material or housing offers sufficient resistance to prevent any dispersion of the radioactive materials from the source under normal circumstances. The encapsulation of the source does not fulfill the requirements laid down in the ISO 2919/1980 norm or an equivalent standard if:
1. the source (as a calibration or measuring source) is produced in-house, or
2. the activity of the source is less than 1 MBq, or
3. the ISO 2919/2012 certificate is no longer available.

- The source holder should be equipped with a clearly visible warning label for radioactivity. If the source is mounted in an apparatus, then the apparatus must also be equipped with a clearly visible warning label for radioactivity.
- The proceedings with a sealed source of low risk, as judged by the General Coordinating Radiation Expert, in consultation with the Radiation Commissioner, should be performed by or under the responsibility of a relevant expert with a diploma RPO MC or higher.
- Applications using more than 10 sealed sources and/or proceedings with a sealed source of more than low risk should be performed by or under the responsibility of a relevant expert with a diploma RPO MC or higher.
- Written safety instructions for working with sealed sources should be present.
- Changing or removing sources from a source holder should be performed according to the written instructions.
- Disposal or transfer of the sources takes place after written consent of the SBE and adaptation of the IT concerned. Disposal or transfer will be carried out in accordance with the applicable regulations.

A sealed source should be checked upon receipt and thereafter at least once per year for contamination by leakage. Contamination is defined as a leakage of more than 185 Bq for β- and γ-emitters and 18,5 Bq for α-emitters. Leakage monitoring should be done by or under the responsibility of a relevant expert with a diploma RPE. The procedures to be followed should be set in writing. Regulations for

these procedures are given in **SV 16 Leakage testing of encapsulated and sealed sources**. The results of the checks should be included in the KEW file. If there has been a contamination, the Radiation Commissioner of the appropriate entity should be informed. The Radiation Commissioner verifies the contamination report and discusses any measures to be taken with the General Coordinating Expert.

Leakage contamination checks should be performed on all sealed sources with an activity of more than 1 MBq and with a radiotoxicity of less than 0,02 Re_{inh}. Gaseous sealed sources do not have to be swipe tested. Sources with an activity of less than 1 MBq and with a radiotoxicity of less than 0.02 Re_{inh} and used on a regular basis such as in education must be wiped at least once every 5 years.

The dose rate around source holders or equipment containing sources should be performed with a periodacy of once per year or more.

A log book of the current sources should be maintained in which the location of the source is given.

Required additions to the **Digital KEW File**:
- Safety instructions for working with the source
- Procedures for leakage contamination monitoring of sealed sources
- Records of leakage contamination checks
- Records of dose rate measurements around source holders or equipment containing sources
- Log book of sources
- For sealed sources: ISO 2919/1980 certificate
- If applicable: work instructions for changing or removing a source from the source holder
- Records must be kept regarding the way in which the source is applied.
- Activities with the source must be kept in combination with a description of the nature and scope of the acts.
- Data of handing over the source if applicable

SV 06 Gas chromatography with the help of a ^{63}Ni electron capture detector

The construction of the ^{63}Ni-source must fulfill the requirements stated in the ISO 2919/2014 standard or an equivalent standard.

The gas chromatograph should be equipped with a clearly visible warning label for radioactivity.

The proceedings with the electron capture detector should be done by or under the authority of the relevant expert with a diploma Ionizing Radiation Level RPO MC or higher. A written set of safety instructions for working with the source must be present.

Installing or removing a source from the gas chromatograph may only be accomplished by or under the authority of the relevant expert with a diploma Ionizing Radiation Level RPO MC or higher.

The output/exhaust of the gas chromatograph should be tested for radioactive contamination at least once per year. If corroding gasses are used in the gas chromatograph, a leakage contamination check on the output of the gas chromatograph should be performed directly after use. Contamination of the output is defined as radioactive leakage of more than 18.5 Bq. A leakage contamination test of the radioactive film need only be performed if contamination of the output of the detector is found. Contamination of the foil is defined as radioactive leakage of more than 18.5 Bq. The leakage contamination check should be performed by or under the authority of a relevant expert with a diploma Ionizing Radiation RPE or higher. The written monitoring procedure to be followed is located in the Local KEW File. Regulations for these procedures are given in **SV 16 Leak testing of sealed and closed sources**. The results of the checks should be included in the KEW file. If a contamination is found, the Radiation Commissioner of the entity must be notified.

Cleaning of the electron capture detector may only be performed by or under the responsibility of a relevant expert with a diploma Ionizing Radiation Level RPE. The written procedure to be followed is located in the Local KEW File. After the cleaning is complete, a leakage contamination check of the film should be performed.

Required additions to the **Local KEW File**:
- Safety instructions for working with the electron capture detector
- Procedure for leakage contamination monitoring of the gas chromatograph
- Records of the leakage contamination checks
- Instructions for cleaning the electron capture detector

SV 07 Open radioactive materials

Open radioactive materials may be used, in principle, in a radionuclide laboratory. The regulations linked to the use of such materials can be found in the regulation **SV 09 Radionuclide Laboratories**.

For the law open radioactive materials are defined as open source: source, not being an encapsulated source, not being an apparatus or accelerator.

The work should be performed according to the procedures stated in Appendix 2 of the permit appendix “Radionuclide Laboratories”, unless the risk analysis of another source is applicable (such as the guide from Wiegman and Grimbergen) and if this is permitted in the Complex Permit, or if the special regulation **SV14 Fissionable Materials** and Ores applies.

Only in a limited number of cases may open radioactive materials be used in designated and outfitted areas outside of a radionuclide laboratory. Such procedures are only allowed if the chance of dispersion of the radioactive material is minimal and should always be discussed in advance with the Radiation Commissioner of the entity concerned .

Required additions to the **Digital KEW File**:
- Safety instructions for the proceedings
- Work instructions for the proceedings
- Records of the stock supplies, use and waste

SV 08 Highly active sources (HASS)

Definition: a highly active source is a sealed source (HASS) where the activity is higher than the legally set activity level. Please note: a highly active source remains a HASS until the activity has fallen under the level of activity defined by the legislator for high activity sources sealed sources.

In addition to the requirements stated in SV05, the highly active source should fulfill the requirements stated in the Radiation Protection Decree and associated regulations. In practice, this means that:

- The integrity of the highly active source should be checked yearly by or under the authority of the Radiation Protection Officer. In principle, the leak test specified in SV05 and performed on the source holder can serve as such.
- The presence of the highly active source should be periodically verified. If the souce is used more often than once per three months, then the frequency of the check can be once per year. If the source is used less often, then the frequency of the presence check should be once per quarter.

Required additions to the **Digital KEW File**:
- Records of the periodic presence control

See also: **IV13 – Highly active sources and protection of radioactive materials**

SV 09 Radionuclide Laboratories

All experiments should have a protocol and a risk analysis present in the lab.

A radionuclide laboratory must comply with the requirements stated in the permit appendix "Radionuclide Laboratories". A portion of these requirements can already be found in the **General Regulations**. In addition, the following requirements, among others, also apply.

The construction and outfitting of a radionuclide laboratory should comply with the requirements stated in the appendix "Radionuclide Laboratories". These requirements are partially dependent on the type of radionuclide laboratory. The type of laboratory is in turn determined by the nature and scope of the desired proceedings in the laboratory.

The Internal Permit indicates what the maximum radiotoxicity equivalent level per nuclide may be present and used in the radionuclide laboratory.

The proceedings in a radionuclide laboratory should be carried out by or under the authority of the relevant expert with a diploma Ionizing Radiation Level RPE. Written safety instructions should be present in the laboratory for both accessing the lab and working in the lab.

Users of the laboratory should possess a diploma Ionizing Radiation Level RPO DRM D or an equivalent level.

All experiments should have a protocol and a risk analysis present in the lab. Before implementing a new experiment, such a protocol should be written and discussed with the Radiation Protection Officer. The protocol consists of at least a description of the following:
- the actions and their durations,
- the protection measures available, if these deviate from the standard measures, and work and safety instructions,
- the required amounts of radionuclides and other materials,
- the waste that is produced by the actions,
- the load factor that the experiment yields for the laboratory, calculated according to Appendix 2 in the appendix "Radionuclide Laboratories", if this calculation method is chosen.

Dose Restriction:
Individual protocols are analyzed per action or experiment (series of related actions), whereby a risk analysis is performed using the pqr-formula (in accordance with the Radionuclide Laboratories Guideline) and the contribution to the load factor (belastingsfactor) is determined per experiment. A dose limitation of 10% of the maximum load factor of 1 is used as a per-individual protocol limitation. If the dose limitation within a protocol is exceeded, a further analysis should take place in which the effective and equivalent dose are determined for the relevant protocol.

A log book should be present in which the experiments are registered. The following information should be included:
- the date and time of the experiment,
- the name(s) of the person (people) performing the experiment and,
- the protocol according to which the experiment is conducted.

Regular contamination monitoring of the laboratory should be performed by or under the authority of the Radiation Protection Officer. The frequency with which these controls should be carried out is dependent upon the nature and frequency of the proceedings in the radionuclide laboratory. The procedure to be followed and the regularity with which these contamination checks should be performed should be stated in writing. The regulations for this procedure are given in **SV 15**

Contamination monitoring of open radioactive sources. The records of these checks should be kept in the Local KEW file. If a radioactive contamination is found, then this should be decontaminated by or under the supervision of the Radiation Protection Officer.

Objects used for working with radioactivity in a radionuclide laboratory may only be taken outside the laboratory if they are not contaminated with radioactivity. If materials which have left the laboratory will be used elsewhere, then a release limit applies which is smaller by a factor of 10 than the release limit for waste, i.e. 0,4 Bq/cm^2 for bèta- and gamma emitters, and 0,04 Bq/cm^2 for alfa-emitters. The Radiation Protection Officer should keep records of the types, amounts, chemical composition and storage place of the radionuclides that are present in the laboratory. The manner in which the supply is controlled and purchased should be given in writing.

The regulation **Radioactive Waste** applies for the handling of radioactive waste.

The regulation **AV 11 Notification** applies for emissions to the air and water.

The non-radiation expert cleaning staff of the RUG or a cleaning company hired by the RUG must be instructed regarding the applicable rules and safety aspects, and they may not handle any (potentially) radioactive materials. See **IV 07 Cleaning** for implementation of this policy.

The Radiation Protection Officer should keep records of the exposed workers who have access to the laboratory, their category classification, their level of expertise and the measurements of their TLD badges. The result of the medical exam should be kept with the General Coordinating Expert. The Radiation Protection Officer confirms that an A-worker is suitable for work in a radionuclide laboratory and informs the General Coordinating Expert. The Radiation Protection Officer should keep records of all the non-exposed workers, such as cleaning staff, who have access to the laboratory.

The request to withdraw an Internal Permit for working with radioactive materials in a radionuclide laboratory should follow the general regulation **AV 03 Withdrawal of an Internal Permit** and the procedures stated in Chapter 12 of the appendix “Radionuclide Laboratories”. It is recommended to contact the Radiation Commissioner and the General Coordinating Expert early in the process in the event of dismantling a radionuclide laboratory.

Required additions to the **Digital KEW File**:
- General work instructions and safety instructions regarding access to and working in the laboratory
- Protocols of experiments.
- Logbook.
- Procedure for contamination checks.
- Administration of contamination controls.
- Instructions in case of incidents
- List of incidents
- Stock management procedure and method of replenishment (purchasing).
- Stock administration.
- Waste plan
- Administration of exposed workers.
- Administration of non-exposed employees.
- Substitute supervisor
- Map in which the lab(s) are drawn
- Risk assessment and evaluation

SV 10 Irradiation or treatment of laboratory animals with radionuclides

Laboratory animals should be handled according to the law regarding animal testing. This means that a recognized expert, a so-called Article 9, 12 or 13f.2 officer, should be involved in applying and implementing the animal testing.

Before an animal experiment can be assessed by the Radiation Protection Officer for radiation safety and radiation load aspects, permission from the Central Commission on Animal Experiments (CCD) should be obtained to perform the experiment. After permission has been obtained from the CCD, the general regulations and agreements should be stated in a work protocol in consultation with the Animal Welfare Body (AWB). The risk analysis is then assessed by the Radiation Protection Officer and the conditions regarding the radiological portion of the work are set.

Laboratory animals treated with radionuclides should be isolated such that any dispersion of radioactivity is prevented. Animal housing should be placed in an area that falls under the regime of a radionuclide laboratory and should be equipped with the inscription “RADIOACTIVE”. If an animal house falls outside of the regime of a radionuclide laboratory, only those animals treated with radionuclides may be kept there to reduce the chance of radioactivity dipersion to null, and the external radiation should be negligible. The bodies of animals that have been treated with radionuclides should be treated as normal **Radioactive Waste**.

Required additions to the **Digital KEW File**:
- Regulations regarding working with laboratory animals

SV 11 Radiodiagnostic research on humans

The *treatment of humans with radionuclides for research or therapy is not permitted* within the scope of the Complex Permit of the RUG. If such a treatment is desired, the Complex Permit must be adjusted. This requires about one year to accomplish so contact with the General Coordinating Expert should be made very early in the planning for the experiment!

Radiodiagnostic research on humans is only allowed within the scope of the Complex Permit if the radiation occurs as a part of a dental exam.

The following rules apply for a radiodiagnostic dental exam in humans in addition to those stated in the regulation **SV 12 Devices**:

Each irradiation must be justified on medical grounds. There must be a written procedure in which the following radiation safety points are addressed:
- when new photos of the patient may be made,
- how is the radiation load for the patient and worker kept as low as possible, and
- who is authorized to service the device.

All the results of an X-ray diagnostic exam should be placed in the file of the applicable patient.

Required additions to the **Digital KEW File**:
- Radiation safety work instructions
- Mobile equipment: logbook with data on the location and the use

SV 12 Devices

Working with an X-ray machine, X-ray diffraction device or an electronmicroscope should be performed by or under the authority of the relevant expert with a diploma Ionizing Radiation Level 5A, TS RM, TS MR-T or similar or higher.

If the device is in use, the dose rate outside of the radiological area where the device is located should not be more than 1 mSv per year. The device should comply with the applicable accepted safety regulations and should be labeled with a clear radioactivity warning sign. The device and the associated protection and shielding should be checked for proper operation once per year by a relevant expert. A report of these checks should be kept with the device.

Written work instructions should be present. If maintenance is performed by the Radiation Protection Officer, written maintenance instructions should also be present.

If work on the device could have radiation safety consequences, the device should be checked after the work is completed to ensure proper operation of the device. The report of the check should therefore include a summary of the maintenance or work done on the device.

Required additions to the **Digital KEW File**:
- Technical data of the device(s)
- Work instructions for working with the device
- If applicable: maintenance instructions for the device
- Records of the device checks, supplemented with any reports concerning the work or maintenance of the device

Maintenance device by third parties
The Radiation Protection Office has to ask the involved company for the permit regarding maintaining and repairing ionizing radiation transmitting equipment like EM. If the company has no permit, the maintenance or repair has to be performed under direct responsibility of the Radiation Protection Officer.

Specific regulations:
- The technician reports to the Radiation Protection Officer and follows his direction.
- If the company does not have a permit and/or is not allowed to perform a radiation safety check, the Radiation Protection Officer carries out the radiation safety check.
- A specific protocol should be present for the check of the interlock systems and measuring of the dose rate. This protocol should be part of the KEW file on RADMIN. Special attention should be given to the sensitivity of the dose rate monitor for low energies.
- The results of the survey are included in the service report and filed on RADMIN.
- When relevant, the Radiation Protection Officer asks the company to supplement their protocols regarding radiation safety during maintenance and repair.

SV 13 Accelerators

Definition: An Accelerator is an apparatus with an accelerating voltage of 1 MV or more, or an apparatus that can accelerate particles to an energy of 1 MeV or more.

Within the grounds of the RUG, the following pre-existing Accelerator is in use:
- the AGOR cyclotron at Zernikelaan 25 (KVI),

Before a new Accelerator may be used, the Complex Permit of the RUG must be adjusted. This requires about one year to accomplish so contact with the General Coordinating Expert should be made very early in the planning!

The effective dose as a consequence of the use of an Accelerator at the site boundary of the RUG should comply with what is stated in the regulation **AV 11 Notification**.

The use of the abovementioned Accelerators and accessories should be done within the provisions of the current versions of the safety reports:
- AGOR Safety report,

Changing the content of a safety report should be done in consulation with the General Coordinating Expert, who thereby complies with the regulation **IV 02 Changing documents that form a part of a Complex Permit**.

The proceedings with a Accelerator should be performed under the supervision of a Radiation Protection Officer with a diploma Ionizing Radiation Level 3 or higher. In accordance with the Safety Report AMS, it is sufficient that a Radiation Protection Officer has a diploma Ionizing Radiation 4A level or higher for this application.

SV 14 Fissionable materials and ores

Notice:
This regulation does not apply to fissionable materials and ores that are used as:

1. Encapsulated radioactive sources or sealed sources according to RUG specifications (**SV 05** applies in this case),
2. Open radioactive materials in easily dispersible (in radionuclide laboratories) forms (**SV 09** applies in this case).

The chance of dispersal of fissionable materials and ores should be null under normal circumstances.

If the radioactive noble gas Radon can be relased, its accumulation should be prevented by adequate extraction or ventilation.

Working with fissionable materials or ores should be performed by or under the authority of the relevant expert with a level of education that will be determined after consultation with the General Coordinating Expert on the basis on an RI&E.

Materials containing fissile material or ores shall bear adequate warning signs.

Written safety instructions for the proceedings should be present.

Written work instructions should also be present and should describe how the released waste should be treated and the manner in which the waste should be disposed.

Records should be kept of the stock supply, use and discharged waste of fissionable materials and ores. The discharge of radioactive waste is regulated by the regulation **SV 04 Waste and Discharge**.

Required additions to the **Digital KEW File**:
- Safety instructions for working with fissionable materials and ores
- Work instructions for proceedings with fissionable materials and ores
- Records of the stock supply and usage

SV 15 Contamination monitoring of open radioactive materials

In the procedure for periodic monitoring of contamination in locations where open radioactive materical are used, attention should be paid to the following points:

General
- Evaluating and recording of the frequency with with the monitoring should be performed

With regards to swipe testing
- An evaluation of the areas to be checked
- Setting the surface of the area to be monitored
- Manner in which the monitoring will be done
- Radiation safety measures to be taken (shielding, collecting material, etc)

With regards to measurements
- Which measuring devices should be used for which isotope
- Which specific radiation is used for the measurement
- Annual check of measuring equipment
- The measuring device should be able to detect the minimal legal detection limit. This should be determined by taking a practical measurement.
- In which manner the measuring results are presented

SV 16 Leak testing of sealed and closed sources

In the procedure for performing periodic (i.e. annual) monitoring of leakage contamination of encapsulated or sealed sources, attention should be paid to the following points:

With regards to swipe testing
- An evaluation of monitoring the source or source holder, taking into account the activity and reliability of the encapsulated or sealed source
- Manner in which the monitoring is performed
- Radiation safety measures to be taken (shielding, preventing falls of the source, collecting materials, transport, etc)

A sealed source must be checked for leak contamination on arrival and thereafter at least once a year. The leak contamination checks must be carried out by or under the responsibility of an expert with a diploma in Ionizing Radiation level 3, CD or higher. The procedures to be followed must be in writing. Leak contamination checks need not be performed for sealed sources with an activity of less than 1 MBq and with a radiotoxicity of less than 0.02 Re_{inh}, and for gaseous sealed sources.

With regards to measurements
- Which measuring devices should be used for which isotope
- Which specific radiation is used for the measurement
- Annual check of the measuring device
- The measuring device should be able to detect the minimal legal detection limit. This should be determined by taking a practical measurement.
- In which manner the measuring results are presented

SV 17 Notification

In the following cases, an application for an Internal Permit is not required and suffice a notification. A notification can be done using the **notification form (F05).** Please note that the legal framework remains in force even in the case of a notification.

The following general applications are involved:

1. Devices having a rated voltage of not more than 30 kV which, under normal operating conditions, do not exceed an ambient dosage-equivalent rate of 1 μSv per hour, other than electron microscopes or X-ray diffraction, at a distance of 0,1 m from any accessible surface of the apparatus.

2. Radioactive material which, if considered separately at the involved location, would be exempted under the Decree on Basic Safety Standards for Radiation Protection, Section 3.3 or the Decree on Nuclear Installations, Fissile Materials and Ores.

In addition, for the following specific applications, for which the SBE has a generic RI&E available, a notification is also sufficient:

1. the possession and use of powders and solutions containing uranium for the purpose of electron microscopy or X-ray diffraction. A maximum of 16,6 kBq (1,3 grams) of natural or depleted uranium in 2% solution is permitted. For larger quantities an Internal approval must be requested and the operations must be carried out within an isotope laboratory. The regulations mentioned in **SV18 Substances containing uranium in small quantities** applies.

2. The possession and use of a limited number of (old) utilitarian objects (such as dials containing radium or emergency signal containing tritium) and small quantities of natural uranium or thorium-containing stone/minerals, solely for demonstration purposes (exhibitions or education). The condition for this is that under normal circumstances the ambient doses equivalent rate at 0.1 m from any accessible outside of (the housing of) the object does not exceed 1 microsieverts per hour. The regulations mentioned in SV20 Utensils and stone/minerals applies.

3. The possessing and using sealed radioactive sources in liquid scintillation counters. For all activities involving sources from liquid scintillation counters, it is necessary to apply for an Internal Permit to the extent that these exceed the applicable exemption limit.

For each notification, the applicant must appoint a contact person who already works as the Radiation Protection Supervisor for a current Internal Permit. If this is not available, an Internal Permit must still be applied for.

After drawing up a generic RI&E, the SBE may decide to settle for a notification for other applications as well if the risk to employees and the environment is negligible at all times.

If a notification appears to involve a higher risk than that taken into account in the RI&E, an Internal Permit is still required.

SV 18 Uranium-containing materials in small quantitites

This instruction applies for the possession and use of uranium-containing fissionable materials or ores consisting less than 1,3 gram of depleted uranium in 2% solution.

Natural uranium is defined as uranium in which the mass of the uranium isotope is equal to that found in nature. In practice, this refers to uranium ores. If the mass of U-233 and U-235 is lower than in natural uranium, this is referred to depleted uranium.

It is recommended that the stock be managed by one person with the research group, preferably by a Radiation Protection Officer or someone else who has an Ionizing Radiation diploma. If the manager is not a Radiation Protection Officer or Radiation Commissioner, a Radiation Protection Officer or Radiation Commissioner should be found who will function as the contact point for the application.

The person who manages the uranium-containing material should minimize the risk of irradiation or contamination as a result of this material by using work instructions and safety instructions. Standard work instructions and safety instructions, consisting of all relevant elements, for uranium-containing fissionable materials are given in **IV 08 Work and safety regulations for uranium-containing materials**.

The manager should maintain simple stock supply records.

Required documents:
- Work and safety instructions
- Simple stock supply records

SV 19 The use of ionizing radiation at other locations of the UG and at varying locations in the Netherlands

This regulation relates to the application of ionizing radiation at locations that are not explicitly named in the Complex Permit Nuclear Energy Act and its associated applications.

The application of ionizing radiation at such locations is only allowed if this is explicitly stated in the Internal Permit.

If no permanent supervision is present (as is often the case in field stations), the following rules will supplement the general regulations:
- the location may not be open to the general public;
- a logbook is present of the location of the source or sources;
- transport is carried out according to the rules and legislation;
- there should be a provision whereby problems with the application can be reported to the Radiation Protection Officer within a reasonable period of time.

Required addition to the **Digital KEW File** exclusively for applications at *other locations of the UG*:
- map of the building or terrain on which the application takes place.

SV 20 Radioactive demonstration materials
This regulation relates to the possession and demonstration of radioactive utensils, stones and/or minerals for demonstration purposes.

The possession and demonstration of radioactive utensils and/or ores/minerals is only permitted if this has been made notified to the SBE by means of an Internal Permit. The conditions under which a Notification is sufficient are described in chapter 4. If these conditions cannot be met, an Internal Permit must be requested.

The possession and use of (old) utensils (such as radium-containing dials or tritium-containing emergency signals) and small quantities of natural uranium or thorium-containing stones/minerals is only permitted for demonstration purposes (exhibition or education).

Conditions for storage of this material:
- A local supervisor with a relevant diploma in radiation hygiene has been appointed.
- The storage location is sound and closed to unauthorized persons.
- An annual overview of the available material is given.

Conditions under which this material may be used for demonstrations:
- An Internal Permit has been issued or an Internal Notification has been made for the demonstration of the material.
- Demonstrations are performed by or under the direct supervision of the local supervisor.
- A register is kept of the location where the material is demonstrated and which items are involved.
- This register also records when the material has been placed back in the storage location.
- Under normal conditions, the ambient dose equivalent rate at 0.1 m from any accessible exterior of the object (or housing) should not exceed 1 μSv per hour.

Demonstrations with this material are only allowed within your own organization, provided there is no transport on public roads. If transport via public roads is necessary, SV19 will come into effect and an Internal Permit for the material must be requested.

The register of demonstrations is kept within the **Digital KEW file**.