

## Radiation Protection Instructions of the Research Reactor TRIGA Mainz

### Preamble - Disclaimer

This is an English version of the radiation protection instructions of the TRIGA Research Reactor Mainz. It is meant to be a helpful document for non-German speaking internal and external researchers, workers in radiation protection areas and others.

In fact, the German version of the radiation protection instructions of the TRIGA Research Reactor Mainz is the only legally binding version.

### **1. Introduction**

When handling radioactive materials, there is a possibility of exposure from external radiation sources or from incorporation of radioactive substances. Contamination of the skin, clothing or work objects can also result in external or internal radiation exposure.

The aim of these radiation protection instructions is to take appropriate action to keep any exposure or contamination as low as possible, even below the limit values. The radiation protection instructions are binding for all employees, as well as any guest scientists and external personnel in all radiation protection areas of the TRIGA Mainz in the buildings 1.261-1.264.

### **2. Legal Bases**

Legal bases for the radiation protection instructions are:

- the „Strahlenschutzgesetz (StrlSchG)“, (German Radiation Protection Act) <sup>1</sup>
- the Strahlenschutzverordnung (StrlSchV), (German Radiation Protection Ordinance) <sup>2</sup>
- the licence for handling of radioactive material for the TRIGA and its laboratories, as well as the requirements defined in regulatory orders and notices, whenever they concern radiation protection matters (see section 4).

### **3. Scope of Application**

The scope of application for these radiation protection instructions are all radiation protection areas of the

Research Reactor TRIGA Mainz  
Fritz-Straßmann-Weg 2  
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<sup>1</sup> Gesetz zum Schutz vor der schädlichen Wirkung ionisierender Strahlung (Strahlenschutzgesetz - StrlSchG) in der derzeit gültigen Fassung

<sup>2</sup> Verordnung zur weiteren Modernisierung des Strahlenschutzrechts (Strahlenschutzverordnung - StrlSchV) in der derzeit gültigen Fassung

All persons working in radiation protection areas in the buildings 1.261, 1.262 and 1.264 of the Johannes Gutenberg University Mainz must comply with these radiation protection instructions and follow the instructions of the radiation protection officer or his representatives.

#### **4. Nuclear Licence for the TRIGA and its laboratories**

The nuclear license issued by the competent supervisory authority, excerpted in [Annex I](#), authorizes the handling of nuclear fuels and other radioactive materials within the TRIGA buildings.

The planned handling of radioactive materials must always be communicated to the radiation protection officer to ensure compliance with the licensing values; this applies in particular to orders and deliveries of radioactive materials.

In principle, in laboratories designed for handling radioactive substances, it is allowed to handle radioactive material with activities up to 100 times the exemption limit, under consideration of the sum formula<sup>3</sup>.

The exemption limits for the individual radioisotopes can be found in Annex 4, Table 1, columns 2 and 3 of the German Radiation Protection Ordinance.

Handling of activities higher than 100 times the exemption limit is only allowed in the reactor hall (Building 1262, Room -1 240), in the isotope magazine (Building 1262, Room -1 122), in the hot laboratory (Building 1262, Room -1 128) and in the controlled area on the first floor of the building 1264. In these laboratories, handling of radioactive materials is generally permitted with activities up to 10<sup>5</sup> times the exemption limit. If several of the licensed radioactive substances are to be handled in one room, the sum formula must also be used to achieve handling in compliance with the license. For the radionuclides explicitly mentioned in the nuclear license (see [Appendix I](#)), deviating values apply for the handling in the radiation protection areas.

The handling of radioactive substances in the isotope magazine is restricted to the employees of the radiation protection group.

#### **5. Radiation Protection Organization**

The President of the Johannes Gutenberg - University Mainz performs the duties of the radiation protection supervisor.

The current radiation protection organization, with a listing of all (deputy) Radiation Protection Officers, all members of the radiation protection staff as well as the authorized medical practitioner, can be found in [Annex II](#).

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<sup>3</sup> The sum of the ratios of the handled activities divided by the maximum allowed value must stay smaller than 1.

## 6. Access regulations to radiation protection areas

### 6.1 In General

Access to premises within the scope of this instruction is regulated by the head of institution in cooperation with the head of site security and in agreement with the radiation protection officer.

Access to controlled areas is prohibited for young people under 18, insofar as it is not necessary for their education. A guided tour at the reactor (e. g. school classes) for educational purposes can be taken from the age of 16.

Special regulations apply to pregnant and breastfeeding persons according to §69 StrlSchV. Therefore, pregnancy must be communicated to the radiation protection officer as early as possible. Access to controlled areas is prohibited to pregnant and breastfeeding persons. If there is a special reason, access to monitoring areas may be allowed by the radiation protection officer, but only if an inner occupational exposition is excluded and it is ensured by suitable monitoring measures that the special dose limit according to § 78 StrlSchG is complied with and that this is documented on a weekly basis.

### 6.2 External Staff

In the case of external staff (guest scientists, trainees, craftsmen, company representatives, etc.), it must be checked beforehand whether the person concerned belongs to the group of "occupationally exposed persons" or becomes an occupationally exposed person through the activity in the radiation protection area, and which measures are required. The radiation protection group checks which monitoring measures are required before the start of the operation. Non-official dose monitoring by the TRIGA radiation protection is required in any case.

For activities covered by § 25 StrlSchG<sup>4</sup>, a demarcation agreement must generally be concluded in advance with the University of Mainz and, if necessary, dose reference values must be specified. In addition, external staff needs a radiation passport and is allowed to start working after the Radiation Protection has checked their documents and no objections have been raised. For external staff which is monitored outside Germany and therefore does not have a radiation passport, a document containing the information of a radiation passport must be provided.

### 6.3 Visitors

Any visitor who wants to enter a room in which radioactive materials are handled needs a permission of the radiation protection officer or one of his deputies. Entering the reactor hall needs an additional permission of the head of institution and the head of site security (see [6.1](#)).

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<sup>4</sup> These are all persons that may receive an effective dose of more than 1 mSv per year in external radiation protection areas.

## 7. Working on external plants and installations

Planned activities in external radiation protection areas of persons who work within the scope of this instruction and are monitored by the radiation protection of the TRIGA Mainz research reactor must be early reported to the radiation protection office. In particular, their type and duration must be mentioned here, since further precautions such as a demarcation agreement and the keeping of a radiation passport (§ 68 StrlSchV) may have to be taken. In principle, the official dosimeter has to be worn in foreign radiation protection areas if the activities carried out there are subject to personal dose monitoring according to German law. The radiation protection officer may make other arrangements in individual cases.

## 8. Instruction

Every person who works in radiation protection areas as defined by the radiation protection legislation must be instructed verbally in accordance with § 63 StrlSchV. The content for the instruction is defined in the radiation protection legislation. This instruction must be given for the first time before starting to work and must then be repeated annually. A member of the radiation protection staff carries out this instruction. Records containing the content and time of the instruction shall be signed by the instructed person. If the last instruction was more than one year ago, the radiation protection officer may prohibit the person from working in radiation protection areas.

Unaffected by this instruction, the respective supervisor/specialist group leader must additionally ensure a workplace-related instruction before the start of an activity.

## 9. Determination of body doses

Occupationally exposed persons are obliged to wear an official film dosimeter or an official albedo dosimeter. These official dosimeters are personal. At the turn of the month, the dosimeter has to be exchanged for the new dosimeter laid out in the storage box provided for this purpose. The radiation protection staff needs to have access to the dosimeter at all times.

The radiation protection officer decides the type of official dosimeter. The dosimeters are issued by the radiation protection staff. Considering the radionuclides to be handled, the radiation protection officer may specify further monitoring procedures (see “Guideline for physical radiation protection monitoring”<sup>5</sup>), e.g. finger ring dosimeters or neutron dosimeters. Independently of this, each employee can be assigned to an electronic dosimeter. The personal dosimetry has to be worn when entering any radiation protection area.

The results of personal dosimetry monitoring are documented.

If, based on the determination of the body dose, it is suspected that one of the dose limits of §78 StrlSchG has been exceeded, the body dose has to be determined taking into account the exposure

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<sup>5</sup> Richtlinie zur physikalischen Strahlenschutzkontrolle (RiPhyKo)

conditions. The body dose determined will be communicated to the person concerned and transmitted to the competent authority together with the information on the exposure conditions.

If it is suspected that a person has incorporated radionuclides, the radiation protection officer has to be informed immediately. He contacts the authorized medical practitioner and decides in consultation whether an incorporation control (whole-body measurement, excretion analysis) has to be taken. The radiation protection officer also decides on regular incorporation control on basis of the relevant regulations.

## 10. Contamination control of persons

According to § 58 StrlSchV, persons leaving radiation protection areas where open radioactive materials are handled are obliged to carry out a contamination measurement. For this purpose, hand-foot-clothes contamination monitors (HFK monitors) are available at the exits of controlled areas and near the monitored areas. If a contamination is detected the Radiation Protection Team has to be informed immediately and measures must be taken to avert a hazard from further spread or incorporation (see [Appendix III](#), "Instructions for Conduct in the Event of Contamination").

Additionally, all employees and visitors are required to perform a contamination measurement at the HFK monitor located at the main entrance before leaving the building.

In the event of contamination, the Radiation Protection Team has to be informed immediately. If no radiation protection staff member is available on the premises (for example, in the evening hours or after entering the building on weekends), the TRIGA on-call service has to be informed by telephone, which will initiate further steps. The relevant telephone numbers can be found in [Appendix II](#) and [Appendix III](#) and are posted in close proximity of the HFK monitors.

If contamination is still measurable after decontamination measures, the building may only be left with the approval of the radiation protection officer.

## 11. Occupational health monitoring

Every occupationally exposed person who wants to work within the scope of the above-mentioned authorization and who is assigned to category A by the radiation protection officer in accordance with §71 StrlSchV must be examined by an authorized medical practitioner at the instigation of radiation protection in accordance with §77 StrlSchV before commencing work and annually thereafter. These persons may only work in radiation protection areas if they have a certificate issued by this doctor stating that there are no health concerns for their planned tasks. Accordingly, the application of new employees at the radiation protection team has to be notified with sufficient advance notice of at least two weeks. The authorised doctor is responsible for making appointments and transmitting the examination results. The authorized medical practitioner is responsible for appointment allocation and transmission of examination results.

Individuals who are passing an internship as part of their studies or who are classified as category B or no category by the radiation protection officer due to the scope or period of the planned activity are not subject of the occupational health monitoring. However, if dose levels are reached that require a

classification in category A, the individual will be assigned to category A by the radiation protection officer and consequently will also be subject of the occupational health monitoring.

When all activities as occupational exposed person are finished (e.g. by terminating an employment contract or at the end of bachelor thesis etc.), it must be ensured that occupational health monitoring continues with the consent of the person concerned for as long as the authorized medical practitioner considers it as necessary.

## 12. Personal protective equipment (PPE)

Usually, a white or grey protective coat with red collar or a jacket, both marked with the label "TRIGA Mainz" is provided as protective clothing. These have to be worn when working with radioactive materials. In the hotlab (Building 1262, Room -1 128) and in the controlled area on the first floor of the building 1264, the orange protective coats and overshoes or separate laboratory shoes provided there have to be worn. When working in the area of the reactor tank, the primary cooling circle, at the radioactive waste water system and the filter devices of the exhaust air systems orange overalls and overshoes have to be worn, if necessary. For individuals with open wounds or skin diseases (especially on the hands) working with open radioactive substances is prohibited, unless incorporation cannot be safely ruled out by protective measures. In cases of doubt, the authorized medical practitioner decides involving the radiation protection officer.

In principle, suitable protective gloves have to be worn, when handling open radioactive substances. Between the individual work steps, protective gloves and working equipment has to be checked for contamination. Care should be taken, that nothing will be touched with contaminated protective gloves (especially no door handles, telephones, light switches, radiation protection measuring devices, etc.) and that they are proper disposed. Wearing potentially contaminated protective gloves in measuring rooms is also prohibited.

## 13. Basic rules of radiation protection

The following basic rules of radiation protection have to be obeyed all times:

- The "ADDS" (in German: "4-A's of radiation protection – Aktivität, Aufenthaltsdauer, Abstand und Abschirmung) for operational radiation protection have to be obeyed:
  - Activity: Limit activity to the lowest value with which the task can be solved
  - Duration: Minimize the time spent handling radioactive materials
  - Distance: Keep distance to radioactive materials as large as possible (use tools)
  - Shielding: Use shielding in an appropriate manner and to a reasonable extent
- In all radiation protection areas, behaviour through which radioactive substances can be absorbed, in particular eating, drinking, smoking and the use of health care and cosmetic products is prohibited.
- Each employee has to organize and perform his work in such a way that he and other persons are not unnecessarily exposed or otherwise endangered.
- Radioactive materials may be placed in the workplace only in the quantities and only for as long as necessary for the work operation. Vessels containing radioactive materials shall not be left open or outside suitable containers longer than necessary.

- Work with open radioactive materials or experiments in which radioactive materials may be released shall be performed in a fume cupboard.
- Open radioactive substances may only be transported in suitable containers by the shortest route to the respective permitted handling locations.
- Storage containers for radioactive substances have to be labelled. The labelling must include at least the words "radioactive," radiation symbol (available from the radiation protection staff), radionuclide, activity, date, substance name, and user.
- The use of mouth-operated devices is prohibited. Pipetting and similar work may only be carried out with appropriate equipment (pipetting aids).
- The work surfaces and - if possible - also the equipment (stands, laboratory boy, etc.) need to have a surface that is easy to decontaminate and, if necessary, have to be protected by masking with a suitable film to facilitate any decontamination that may be necessary.
- Before leaving the workplace, especially after finishing the daily work, the workplace has to be checked for contamination. Any contamination has to be removed or the contaminated area has to be marked. The Radiation protection staff has to be informed immediately.
- Defects in radiation protection equipment, control equipment or measuring equipment has to be reported immediately to the radiation protection officer.
- Before carrying out work with radioactive substances for the first time, the test procedure has to be tested inactive at first or with smaller amounts of activity. The work can be carried out with the full amount of activity only after sufficient experience has been gained.

#### **14. Acquisition, handing out and transport of radioactive materials**

Orders of radioactive materials are always placed by the radiation protection group. Timely before the acquisition of radioactive materials (purchase, donations, production in other facilities, and so on) the radiation protection group has to be informed about these plans so that it can be checked whether there are any concerns to the acquisition on basis of the legislation or the nuclear license. If there are no concerns, the necessary steps to acquire the substance will be taken by the radiation protection group. As long as they are not in use, newly acquired radioactive substances are stored at the isotope magazine and issued for handling in the laboratory when needed. Afterwards, they always have to be stored in the safe of the corresponding laboratory or at least in protective or shielded containers. They have to be secured against access by unauthorized persons. Radioactive substances are issued from the isotope magazine only on presentation of a form signed by the research group leader.

Any transport of radioactive materials (including standards and sources with small activities) out of the TRIGA buildings – regardless of whether it is carried out by in-house employees or external companies/institutes – has to be arranged with the radiation protection group in good time beforehand. A concerning this matter instructed person ensures compliance with radiation protection -, nuclear -, and transport regulations (packaging, labelling, accompanying documents, handling and transport permits, commissioning of transport companies, etc.).

The costs for acquisition and/or transport of radioactive substances intended exclusively for use in scientific working groups or their cooperation partners are paid by the respective working groups and are not charged to the radiation protection.

In-house employees, who are to carry out transports of radioactive material require approval to do so and have been instructed by the radiation protection officer or his deputy in advance. These two persons also serve as emergency contacts and have to be informed of any incident.

### **15. Loss and submission of radioactive substances and waste**

The loss of radioactive substances has to be reported to the radiation protection officer immediately. Liquid or solid radioactive waste (e.g., contaminated waste water, non-aqueous solutions or organic solvents, dissolved and solid chemicals, disposable material and work equipment) must be treated according to the "Instructions for handling radioactive waste" (see [Appendix IV](#)). Waste can be handed over to the radiation protection group with the needed information and properly declared. Radioactive waste may not be diluted or divided into exemption limit quantities for disposal.

### **16. Release of radioactive material and bringing out of non-radioactive material**

Before bringing anything out of a radiation protection area, the material has to be checked whether it is activated or contaminated. It might afterwards be released (§31 StrlSchV) or brought out according to §58 StrlSchV.

Movable objects (tools, measuring instruments, measurement devices, other devices, article of clothing, etc.) that will be reused or repaired outside of radiation protection areas are checked for activation or contamination by the radiation protection.

The radiation protection group has to document the results of the examination.

All other objects, parts of buildings and fixed constructions have to be released before they can be disposed or used outside of radiation protection areas.

The release of radioactive material at the TRIGA Mainz according to §31 StrlSchV is regulated in the instructions of releasing radioactive materials. This document does not apply for the release of radioactive materials of the building "M-Haupt" or the release of material within the renovation of building 1.261 (laboratory wing).

### **17. Behaviour in case of incidents**

An incident is a deviation from the intended, scheduled normal course of operations in which increased radiation exposures occur or may occur. One speaks of increased exposures if the actual exposures exceed the values expected for normal operation by more than the usual range of variation, even if the limit values are not achieved.

In case of incidents, every employee is obligated to immediately inform the radiation protection officer in person or by telephone.



### **18. Alarm due to fire or other incidents**

In case of an alarm due to fire or other incidents, work has to be stopped, the workplace has to be left in a safe condition and the building must be exited immediately via the stairwells and identified escape and emergency routes. For more information, e.g., about escape and emergency routes, see "Allgemeine Betriebsanweisung Labor" (only available in German).

### **19. Coming into effect**

These radiation protection instructions were put into effect on June 1, 2020 and replace all previous radiation protection instructions.

Mainz, den

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Mainz, den 27.04.2020

## Appendix I

License for handling of radioactive material (excerpt, only available in German)

# GENEHMIGUNG

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nach § 9 des Atomgesetzes

zur Änderung und Ergänzung der Genehmigung  
für den Umgang mit Kernbrennstoffen und sons-  
tigen radioaktiven Stoffen vom 18. August 1998  
einschließlich Folgeänderungen

vom 15.02.2012



Rheinland-Pfalz

MINISTERIUM FÜR  
WIRTSCHAFT, KLIMASCHUTZ,  
ENERGIE UND  
LANDESPLANUNG

## Genehmigung

vom 15.02.2012

### **zur Änderung und Ergänzung der Genehmigung für den Umgang mit Kernbrennstoffen und sonstigen radioaktiven Stoffen vom 18. August 1998 einschließlich Folgeänderungen**

Das Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung des Landes Rheinland-Pfalz erteilt der

Johannes Gutenberg-Universität Mainz für das  
Institut für Kernchemie  
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auf Grund von § 9 Atomgesetz (AtG) vom 15. Juli 1985 (BGBl. I S. 1565) in Verbindung mit § 7 Abs. 2 der Strahlenschutzverordnung (StrlSchV) vom 20. Juli 2001 (BGBl. I S. 1714) in den derzeit gültigen Fassungen folgende Genehmigung zum Umgang mit radioaktiven Stoffen:

Die Genehmigungen vom

- 18. August 1998 (Az.: 10622-1 – 84 826.2/98),
- 15. November 2004 (Az.: 1092 – 84 825.3)
- 21. Juli 2008 (Az.: 10812 – 84 826)
- 21. April 2010 (Az.: 108-84 826-2.1/2010-1)

werden in diesem Bescheid zusammengeführt.

Auf den Antrag der Johannes Gutenberg-Universität vom 30.11.2011 mit den Anlagen 1, 2, 2a und 3 hin sowie zur Anpassung an die aktuelle Sach- und Rechtslage werden wie folgt Umgangsaktivitäten und Umgangsorte geändert und nachträgliche Auflagen auf Grundlage von § 17 Abs. 1 AtG zur Konkretisierung der bisherigen Nebenbestimmungen zur Einhaltung des Standes von Wissenschaft und Technik beim Strahlenschutz erteilt.

### Umgang mit Kernbrennstoffen und sonstigen radioaktiven Stoffen

1. Diese Genehmigung erstreckt sich auf den Umgang mit Kernbrennstoffen und sonstigen radioaktiven Stoffen in den nachfolgend genannten Gebäuden und ist gemäß den Tabellen 1 bis 3 beschränkt.
  - 1261 (ursprüngliches Laborgebäude)
  - 1262 (Reaktorhalle und Reaktorhallenanbau)
  - 1264 (Erweiterungsbau).
  
2. Für die im Reaktor TRIGA MARK II erzeugten Radionuklide gilt diese Genehmigung ab dem Zeitpunkt der Entnahme der Radionuklide aus der jeweiligen Bestrahlungsposition. Bis zu diesem Zeitpunkt unterliegt der bestrahlte Stoff der nach § 7 AtG erteilten Betriebsgenehmigung für den Reaktor.
  
3. Die Entnahme der im Reaktor TRIGA MARK II erzeugten Uranspaltprodukte für den hier gestatteten Umgang ist nur zulässig, wenn die Ausgangsmasse des Spaltmaterials wie folgt begrenzt ist: Bezogen auf die Standard-Bestrahlungsposition im Reaktor ( $\Phi = 1,00 \times 10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$ ) und eine Reaktorleistung von  $100 \text{ kW}_{\text{thermisch}}$  darf bei acht Stunden Bestrahlungsdauer die Menge des zu bestrahlenden U-235 einen Wert von 100 mg nicht übersteigen. Bei kürzeren Bestrahlungszeiten oder anderen spaltbaren Materialien darf die im Reaktor für den darauf folgenden Umgang erzeugte Gesamt-Aktivität den Wert von  $1 \times 10^{12} \text{ Bq}$  nicht überschreiten.

Tabelle 1: Radioaktive Stoffe in offener Form<sup>a)</sup>

| Lfd.-Nr. | Radio-nuklid <sup>b)</sup>                                       | Maximale Aktivität       | Äquivalente Masse <sup>c)</sup> | Umgangsorte (siehe Tabelle 3)                                   |
|----------|--|--------------------------|---------------------------------|---|
| 1        | Th <sup>natür-lich</sup> <sup>d)</sup>                           | 4,1E+07 Bq               | bis 10 kg                       | 12, 13, 14, 15  |
|          |  | 1,0E+05 Bq               |                                 | 24, 25, 26, 27  |
| 2        | Th-232   | 1,0E+09 Bq               |                                 | 8, 9, 12, 13, 14, 15, 24, 25, 26, 27                            |
|          |  | 4,1E+04 Bq               | bis 10 g                        | 19, 20, 21, 22, 23, 28  |
|          |  | 1,0 E+06 Bq              |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18                         |
| 3        | U <sup>natürlich</sup> <sup>d)</sup> (Summe U-234, U-235, U-238) | 2,5E+08 Bq               | bis 10 kg                       | 12, 13, 14, 15  |
|          |  | 1,0E+05 Bq               |                                 | 3, 6, 24, 25, 26, 27  |
| 4        | Uran <sup>abger-eichert</sup> <sup>e)</sup>                      |                          | bis 40 kg                       | 12, 13, 14, 15  |
|          |  | 1,0E+06 Bq               |                                 | 3, 6, 24, 25, 26, 27  |
| 5        | U-233  | 3,6E+09 Bq               | bis 10 g                        | 12, 13, 14, 15  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 28                 |
| 6        | U-235 bzw. mit U-235 angereichert                                | 6,4E+06 Bq               | bis 80 g U-235                  | 12, 13, 14, 15  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18                         |
|          |  | 2,4E+03 Bq (Bezug U-235) | 0,03 g (Bezug U-235)            | 19, 20, 21, 22, 23, 28  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10   |
| 7        | U-238 (Bezug U-238+)   | 1,2E+05 Bq               | bis 10 g                        | 19, 20, 21, 22, 23, 28  |
|          |  | 1,0E+09 Bq               |                                 | 24, 25, 26, 27,   |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
| 8        | Pu-239   | 4,6E+09 Bq               | bis zu 2g                       | 12, 13, 14, 15  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
| 9        | Pu-238   | 5,0E+10 Bq               |                                 | 12, 13, 14, 15  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23     |
|          |  | 1,0E+09 Bq               |                                 | 24, 25, 26, 27  |
| 10       | Pu-240   | 5,0E+10 Bq               |                                 | 12, 13, 14, 15  |
|          |  | 1,0E+05 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
|          |  | 1,0E+08 Bq               |                                 | 24, 25, 26, 27,   |
| 11       | Pu-241   | 5,0E+10 Bq               |                                 | 12, 13, 14, 15,   |
|          |  | 1,0E+7 Bq                |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
| 12       | Pa-231   | 5,0E+10 Bq               |                                 | 12, 13, 14, 15  |
|          |  | 1,0E+08 Bq               |                                 | 24, 25, 26, 27  |
|          |  | 1,0E+05 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
| 13       | Am-241   | 5,0E+10 Bq               |                                 | 12, 13, 14, 15  |
|          |  | 1,0E+09 Bq               |                                 | 24, 25, 26, 27  |
|          |  | 1,0E+06 Bq               |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |

| Lfd.-Nr. | Radio-nuklid <sup>b)</sup>   | Maximale Aktivität | Äquivalente Masse <sup>c)</sup> | Umgangsorte (siehe Tabelle 3)                                      |
|----------|--|--------------------|---------------------------------|--|
| 14       | Am-243   | 5,0E+08 Bq         |                                 | 14, 15   |
|          |  | 1,0E+08 Bq         |                                 | 8, 9, 12, 13, 24, 25, 26, 27                                       |
|          |  | 1,0E+05 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 15       | Cm-248   | 5,0E+10 Bq         |                                 | 12, 13, 14, 15   |
|          |  | 1,0E+08 Bq         |                                 | 24, 25, 26, 27   |
|          |  | 1,0E+05 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 16       | Cf-249   | 5,0E+10 Bq         |                                 | 12, 13, 14, 15   |
|          |  | 1,0E+08 Bq         |                                 | 24, 25, 26, 27   |
|          |  | 1,0E+05 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 17       | Cf-252   | 5,0E+10 Bq         |                                 | 12, 13, 14, 15   |
|          |  | 1,0E+09 Bq         |                                 | 24, 25, 26, 27   |
|          |  | 1,0E+06 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 18       | F-18   | 5,0E+10 Bq         |                                 | 8, 12, 13, 14, 15, 24, 25, 26, 27                                  |
|          |  | 1,0E+08 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 |
| 19       | Sr-90  | 5,0E+10 Bq         |                                 | 12, 13, 14, 15, 24, 25, 26, 27                                     |
|          |  | 1,0E+06 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 20       | Cs-137   | 5,0E+10 Bq         |                                 | 12, 13, 14, 15, 24, 25, 26, 27                                     |
|          |  | 1,0E+06 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 21       | Bk-249   | 5,0E+10 Bq         |                                 | 12, 13, 14, 15, 24, 25, 26, 27                                     |
|          |  | 1,25E+12 Bq        |                                 | <b>14, 15 Umgang befristet bis 01.03.2017</b>                      |
|          |  | 1,0E+08 Bq         |                                 | 1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28    |
| 22       | Ge-68/<br>Ga-68 <sup>d)</sup>  | 5,0E+08 Bq         |                                 | 18, 19   |
| 23       | Für alle namentlich nicht genannten radioaktiven Stoffe darf in den Räumen 8, 12, 13, 14, 15, 24, 25, 26, 27 (siehe Tabelle 3) mit jeweils bis zum 10 <sup>3</sup> -fachen der Freigrenze gemäß Anlage I Tabelle 1, Spalte 2 der StrlSchV umgegangen werden.                                   |                    |                                 |  |
| 24       | Für alle namentlich nicht genannten radioaktiven Stoffe darf in den Räumen 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 16, 17, 18, 19, 20, 21, 22, 23, 28 (siehe Tabelle 3) mit jeweils bis zum 10 <sup>2</sup> -fachen der Freigrenze gemäß Anlage I, Tabelle 1, Spalte 2 der StrlSchV umgegangen werden. |                    |                                 |  |
| 25       | Summe Kernbrennstoffe U-233, U-235, Pu-239, Pu-241 < 15 g und Aktivität des einzelnen Nuklids kleiner als 10 <sup>5</sup> -faches der Freigrenze in den Räumen 24, 25, 26, 27  |                    |                                 |  |

- a) Form im Sinne des § 3 Abs. 2 Nr. 29 a) StrlSchV
- b) Einschließlich herstellungsbedingter Verunreinigungen sowie Zerfallsprodukte
- c) Die Masse ist bei Kernbrennstoffen die maßgebliche Größe für den Umgang
- d) Bezug auf Mutternuklide im Gleichgewicht mit Tochternukliden (Th-232<sub>sec</sub> U-238<sub>sec</sub>)
- e) Bezug auf U-238+ gemäß Anlage III Tabelle 1 StrlSchV je nach Abreicherungsgrad
- f) Umgang nur für Praktikumsversuche (etwa 4 Stunden je Kurs) unter Aufsicht einer fachkundigen Person

Tabelle 3: Einsatzorte für den Umgang mit radioaktiven Stoffen

| Lfd.-Nr.   | Raumbezeichnung und Funktion   | Raum-Nr.                     |
|--|--|------------------------------|
| <b>Gebäude 1261</b>  |  |                              |
| <b>Untergeschoss (Überwachungsbereich)</b>   |  |                              |
| 1  | Messraum   | -1 113                       |
| 2  | Zentrales Labor  | -1 133                       |
| 3  | Labor  | -1 118                       |
| 4  | Messraum   | -1 119                       |
| 5  | Messraum   | -1 121                       |
| <b>Erdgeschoss (Überwachungsbereich)</b>   |  |                              |
| 6  | Labor IV   | 0 118                        |
| 7  | Labor V  | 0 126                        |
| 8  | Syntheselabor/ Qualitätskontrolle  | 0 115                        |
| <b>Obergeschoss (Überwachungsbereich)</b>  |  |                              |
| 9  | Labor VI   | 1 110                        |
| 10   | Labor VII  | 1 118                        |
| <b>Gebäude 1262 (Reaktorhalle und Reaktorhallenanbau) –teilweise Kontrollbereich</b> |  |                              |
| 11   | Dekontamination (Überwachungsbereich)  | 1 218                        |
| 12   | Reaktorhalle (Kontrollbereich)   | -1 240                       |
| 13   | Halle Syntheselabor (Kontrollbereich)  | -1 214                       |
| 14   | Heißlabor (Kontrollbereich)  | -1 228                       |
| 15   | Tresorraum/ Isotopenmagazin (Kontrollbereich)  | -1 222                       |
| 16   | Strahlenschutz Abluftlabor (Überwachungsbereich)   | -2 213                       |
| 17   | Abwasseranlage/ Abfälle (Überwachungsbereich)<br>Sammelräume für radioaktiv belastete wässrige Flüssigkeiten und Abfälle | -2 212/<br>-3 210/<br>-3 212 |
| <b>Gebäude 1264</b>  |  |                              |
| <b>Untergeschoss (Überwachungsbereich)</b>   |  |                              |
| 18   | Abwasser- und Hebeanlage<br>Sammeln radioaktiv belasteter wässriger Flüssigkeiten  | - 1 426                      |
| <b>Erdgeschoss (Überwachungsbereich)</b>   |  |                              |
| 19   | Praktikum Labor  | 00-414                       |
| 20   | Praktikum Spektrometer   | 00-426                       |
| 21   | Low-Level $\alpha$ -/ $\gamma$ -Messraum   | 00-432                       |
| 22   | RIMS Laserlabor<br>Messung Umweltproben  | 00-442                       |
| 23   | Labor Umweltproben   | 00-452                       |
| <b>Obergeschoss (Kontrollbereich)</b>  |  |                              |
| 24   | Labor Speziation/ Migration<br>Speziations-/ Migrationsuntersuchungen, Messpräparatherstellung                           | 01-426                       |
| 25   | Labor Qualitätskontrolle PET<br>Qualitätskontrolle Radiopharmaka   | 01-432                       |
| 26   | Labor Synthese PET   | 01-442                       |
| 27   | Labor Synthese PET   | 01-452                       |
| <b>Obergeschoss (Überwachungsbereich)</b>  |  |                              |
| 28   | Laserlabor<br>Laserspektroskopische Untersuchungen   | 01-414                       |

## Appendix II

### Radiation Protection Organization

| Function   | Name (Tel Nr.)   | Deputy   |
|--|--|--|
| Radiation protection supervisor                          | Prof. Dr. G. Krausch<br>(06131 - 39 22301)   |  |
| Radiation protection officer<br>(RPO)                    | Dr. C. Gorges (-39 25318)  | J. Riemer (-39 25878)<br>restricted*:<br>Dr. K. Eberhardt (-39 25846)<br>Dr. Ch. Geppert (-39 25324)<br>Dr. S. Karpuk (-39 25733)<br>H.-O. Kling (-39 24504) |
| Radiation protection technicians                         | A. Heiser (-39 22324)<br>I. Mittelstedt (-39 28432)<br>A. Nähler (-39 28431)<br>S. Samer (-39 24612) |  |
| Authorized medical practitioner<br>according to StrlSchV | Dr. G. Schmalz ( -17 7401)   |  |

\* temporal restricted takeover of the tasks as RPO, when and as long as the RPO is not available, whereat the decision making is temporal and functional restricted on the initiation of immediate measure, e.g., limitation and elimination of contaminations of employees or objects, as well as medical care measures.



## Appendix III

### Instructions for conduct in the event of contamination

#### 1. Keep calm!

Do not touch anything with contaminated hands (avoid carryover of activity)! An increased  $\alpha$ -value may refer to natural activity, increased  $\beta$ -values are always civilizing activities.

#### 2. Always contact the radiation protection team in case of a contamination!

(Let) call a person of the radiation protection group (see [Appendix II](#)) for support. Depending on the time of day, it is possible that only a deputy radiation protection officer is available. Outside business hours an on call (deputy) radiation protection officer is always available under 0171 277 9040.

The following steps can also be started without a radiation protection team member.

#### 3. Decontaminate: Wash your skin!

For contaminations at the controlled area in the building 1264 there is a basin at the man lock (or at the laboratories). For contaminations in the foyer of the building the next basin for decontamination is at the laboratory 00 126.

Skin will be decontaminated by washing the contaminated area with lukewarm, running water and only after the 3rd washing circle with washing lotion. Do not damage the skin! Do not wash longer than approx. 2 minutes so as not to stress the skin unnecessarily.

Shoes can be washed under running water with the provided brushes.

#### 4. Determine decontamination success!

Regularly, between the washing circles, measure (or have measured) at the HFK or with a mobile contamination monitor whether the contamination has decreased.

#### 5. Discuss further procedure with the radiation protection team

Depending on the amount of the remaining contamination the radiation protection team decides on further measures (Retraction of shoes, further decontamination products, contact to the authorized medical practitioner, etc.). In the case of adherent contaminations at the skin, a glove for example may help that the contamination is transported out of the skin with the aid of perspiration.

#### 6. Finding the cause for the contamination and fix it or have it fixed

If the contamination is not natural, contamination of other persons has to be prevented. This means the hazardous area must be marked to prevent the spread of radioactivity. The decontamination of the hazardous area should start as soon as possible.

**Notice:** A remaining minor residual contamination  $< 10 \text{ Bq/cm}^2$  (reference point) of the skin is usually less harmful than an overstressed skin with the risk of incorporation of the activity. (The epidermis renews itself, therefore a permanent contamination is unrealistic.)

## Appendix IV: Instructions for handling radioactive waste

In the case of radioactive residues, care must be taken to ensure that they are collected correctly and cleanly according to the following criteria. The collecting categories are  $\beta$ -short (half-life:  $t_{1/2} < 10$  days),  $\beta$ -long ( $t_{1/2} > 10$  days) and  $\alpha$ . For solid radioactive waste, the waste bags and bins provided by the radiation protection team have to be used.

The isotope Sr-90 has to be collected separately from other radioactive waste. In addition, nuclear fuel has to be collected separately from other radioactive waste. The radiation protection group can also make special arrangements for the collection of radioactive residuals, e.g., in the case of very short-lived nuclides, with the aim of releasing them according to plausibility.

Care has to be taken to ensure that radiation marks are removed before the residues are given into waste bags. This applies in particular to releasable (low-level radioactive or short-lived) residues. Radiation signs that cannot be made unrecognizable can be handed over separately to the Radiation Protection Team. The contents have to be described to the best of your knowledge; for this purpose, Radiation Protection provides waste cards. Once this is done and the waste is sealed, the Radiation Protection can be notified for pickup.

| Type of Waste          | Category       | Disposal route, notes  |
|------------------------|----------------|--|
| solid, combustible     | $\beta$ -short | Collection in the provided waste bins, separated in the respective category ( $\beta$ -short, $\beta$ -long, $\alpha$ ).<br>Pointed and sharp objects (pipette tip, scalpels, etc.) are collected as solid, combustible waste in PE-bottles and in the respective category. After filling, the closed PE bottles (do not empty!) are transferred to the appropriate waste garbage cans.          |
|                        | $\beta$ -long  |  |
|                        | $\alpha$       |  |
| Glass                  | $\beta$ -short | Please collect $\beta$ -short separately! For these residues, an attempt is made to obtain a release. $\beta$ -long and $\alpha$ -waste are disposed together via the grey glass garbage cans provided in the laboratory. Please do not throw glass containers in the trash after use, try to rinse them. They can be reused in most cases. Also check if there are alternatives to using glass. |
|                        | $\beta$ -long  |  |
|                        | $\alpha$       |  |
| Liquid waste, aqueous  | $\beta$ -short | Disposal via the sinks marked with „weakly radioactive wastewater“. It must not contain long-lived mother nuclides.  |
|                        | $\beta$ -long  | Activity < 500 Bq/l: Disposal via the sinks marked with „weakly radioactive wastewater“.<br>> 500 Bq/l: Solidify as far as possible (precipitate, evaporate, etc.) and hand it over to the radiation protection team.  |
|                        | $\alpha$       | Activity < 5 Bq/l: Disposal via the sinks marked with „weakly radioactive wastewater“.<br>> 5 Bq/l: Solidify as far as possible (precipitate, evaporate, etc.) and hand it over to the radiation protection team.  |
| Liquid waste, organic  | $\beta$ -short | Collection in 5 litre canisters, provided by the radiation protection team. It must not contain long-lived mother nuclides.  |
|                        | $\beta$ -long  | Collection in 5 litre canisters, provided by the radiation protection team. Collect separately according to weak and strong activity.  |
|                        | $\alpha$       | Collection in 5 litre canisters, provided by the radiation protection team.  |
| solid, non-combustible | $\beta$ -short | Collection takes place separately from all other waste and separately according to the respective category. Consultation with the radiation protection team is required.<br>$\beta$ -short waste must not contain long-lived mother nuclides.<br>Aluminium is considered special non-combustible waste and has to be collected separately from other non-combustible waste.                      |
|                        | $\beta$ -long  |  |
|                        | $\alpha$       |  |