

Ruprecht-Karl-University Heidelberg

The authorized representative for radiation protection

**Regulations for the handling of radioactive substances at the Heidelberg  
University (radiation protection area II)**

newly revised edition from 2004, based on the new StrSchV from 2001 and the StrSchAnw  
from 2003 for the Heidelberg University

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## General regulations

1. The conditions given by supervisory authority, by the radiation protection regulation (*Strahlenschutzverordnung*) and by the instruction for radiation protection (*Strahlenschutzanweisung*) of the Heidelberg University must be obeyed.
  
2. The radiation protection agent (who is responsible for the concerned area of radiation protection) designs a user specific instruction for radiation protection in accordance with the department for radiation protection of the “*ZENTRALBEREICH Neuenheimer Feld*”.
  
3. The following items must be offered in printed form or posted in any radiation protection area (accessible to all radiation exposed employees):
  - the radiation protection regulation
  - the instruction for radiation protection
  - this regulation for the handling of radioactive substances at the Heidelberg University (radiation protection area II)
  - user specific instruction for radiation protection
  - the dose limits for the rooms
  - addresses to contact in case of an accident at a radioactive place of work
  - rules of conduct in case of an accident
  - the duties of a radioactive laboratory service (*Isotopenlabordienst*)
  - the instruction for decontamination
  - conditions for the acceptance of radioactive waste
  - if necessary a journal for the Iodine absorption device (*Betriebsbuch Iodisorptionsfilteranlage*)
  - if necessary an operating instruction, an authorization and a building type approval or a test report for a X-ray device
  
4. The safety regulations (*Unfallverhütungsvorschriften*), the legislation on hazardous substances (*Gefahrstoffverordnung*) and the instructions of the agent for biological safety (*Beauftragter für die Biologische Sicherheit*) must also be obeyed.
  
5. Incidents and injuries must be reported **immediately** via the radiation protection agent to the department for radiation protection.

In case of an injury combined with the uptake of radioactive material, the medical treatment has priority.

6. Before starting to work in an radioactive laboratory, the following requirements must be fulfilled:

- registration of a new employee exposed to radiation at the department for radiation protection (see also the form for employees exposed to radiation during work)
- medical entrance examination (certificate by the authorized physician for radiation protection)
- integration in the official dosimetry of persons
- introduction by the radiation protection agent

7. The appointment as radiation protection agent (or as his deputy) requires the following items:

- attending a course in radiation protection (*Fachkundegruppen* 2.1, 2.2, 4.1, 4.2) and possibly a course for actualisation of proficiency (certificate)
- experience in handling open radioactive sources (certificate)
- a certificate stated by the police, that the holder has no criminal record (*Führungszeugnis*)
- registration at the department for radiation protection (see also the form for radiation protection agents)

8. The continuous supervision by the radiation protection agent or by his deputy is required in radioactive laboratories. The head of a department should therefor take care for representatives in case of holidays or sickness.

**Please note:** If the radiation protection agent is not present, or if he cannot be in situ within ca. 30 minutes, all work with radioactive substances must be stopped.

### **Working areas**

9. Working with radioactive substances without authorisation is **forbidden** in any rooms of the University (*Strahlenschutzbereich* II).

10. The authorized total activities of the single radioactive substances (activities of stored and handled sources) in **radiation control areas** are given in the general authorization of the

University. They may not exceed the  $10^4$  times value of the appropriate exemption limit (*Freigrenze*).

11. In rooms defined as operational control areas (*Betriebliche Überwachungsbereiche*) the activity of the radioactive isotope in use may not exceed the exemption limit (*Freigrenze*) or the upper level of activity given by the supervisory authority. If experiments in operational control areas are performed with several radioactive isotopes at the same time then the sum formula (*Summenformel: Anlage IV, Tabelle IV 1 der StrlSchV*) must be applied.

According to this the sum of the ratio of the activity of a single nucleotide and the exemption limit (or the approved amount to work with) may not exceed 1. The upper levels of activity (1 to 5 times the exemption limit (*Freigrenze*)) are given in the general authorization of the University.

12. No radioactive substances may be kept in the shuttle areas or in the buffer zones. Also LSC-devices and other laboratory equipment may not be there.

### **Rules of conduct in an isotope laboratory**

13. Protective clothing and disposable gloves must be put on before starting to work.

14. The following principles of radiation protection have to be obeyed:

- keep the time of exposition as short as possible (e. g. by a careful planning)
- use appropriate shielding (according to the “instructions for radiation protection” and the “radiation protection regulation”)
- keep the distance to the source of radiation as far as possible
- under all circumstances incorporation of radioactive material must be avoided (instant decontamination, protective clothing, protective gloves, protective goggles, frequent measures of contamination, no smoking, drinking eating and make up).

15. In an isotope laboratory (*Kontrollbereiche, Überwachungsbereiche*) You may only put in working equipment or personal items which are necessary for the work with the radioactive material (hence no items like umbrellas, radios, bags etc.).

16. Check your working places! The fume hoods and the floor must be checked for contamination daily with a portable Geiger-Counter (e.g. for  $^{32}\text{P}$ ,  $^{33}\text{P}$ ,  $^{125}\text{I}$ ) or with a wipe test

( $^3\text{H}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$ ) and must be recorded. The samples of the wipe tests (round filters) can be given to the department for radiation protection for measuring.

17. Please mark your working place and contaminated devices and vessels.

18. Working alone in an isotope laboratory outside the normal working time is not allowed.

19. In an isotope laboratory You have to wear closed shoes, laboratory coats and disposable gloves.

20. Use protective goggles (made of acrylic glass or Plexiglas and no lenses that contain heavy metal atoms) when working with radioactive material.

21. Pipetting with the mouth is strictly forbidden. Pipette aids must be used.

22. You must always wear your personal dosimeter. You may not lend it to other persons.

23. Check Your working place before You start Your experiment. In case of contamination ask the persons who worked there before to clean it.

24. Working surfaces must be covered with a waterproof protective foil or with a tub-like pad ("Safe Tray <sup>TM</sup> ", available via laboratory equipment shops).

25. Follow the "rules of conduct in case of an accident" (Verhaltensregeln bei Unfällen und Störfallsituationen) and contact the "addresses to contact in case an accident at a radioactive place of work" (Alarmliste) given in the appendices 1 and 2.

26. A radioactive laboratory service should be established (see appendix 3).

27. Follow the Instruction for decontamination of a radioactive laboratory (see appendix 4)

**Tips for working with  $^{35}\text{S}$ -labelled amino acids and sulphates**

28. Working with the radioactive labelled amino acids methionine and cysteine may give rise to gaseous products because of radiolysis. The amount of these radioactive gaseous fragments depends on the activity and purity of the used products. Please notice the following safety recommendations:

- wear safety gloves, a dosimeter and safety clothing
- follow the safety recommendations of the suppliers
- use highly purified amino acids in stabilised solutions
- open the storage vessels that contain the delivered fresh substances only in a fume hood or in a laminar flow hood. This is also valid for aliquoting and labelling of cell cultures or proteins
- store the aliquots at  $< -20^{\circ}\text{C}$
- thaw the aliquots in a fume hood or a laminar flow hood
- use only marked incubators which are only used for  $^{35}\text{S}$ -labelling for incubating
- put a active charcoal filled dish into the incubator (to absorb  $\text{H}_2\text{S}$  and thiols)
- renew the active charcoal monthly
- used active charcoal, condensed water from the condensation trap and the cleaning agent used for the cleansing of the incubator are disposed as radioactive waste
- de-aerate the incubator into a fume hood if possible
- open the incubator as seldom as possible
- check the working areas, the incubators, the fume hoods and the equipment for radioactive contamination regularly. Remove the contamination immediately!

29. The radiation protection agent checks the necessity of an incorporation monitoring for any one employee. The department for radiation protection supports this task.

30. The department for radiation protection performs workplace measurement if wanted (measuring of the  $^{35}\text{S}$ -concentration in the inside air). Monitoring the inside air may replace the incorporation monitoring under certain circumstances.

### **Tips for working with radioactive labelled animals and plants**

31. Experiments with plants and animals in which radioactive substances are applied may only be performed in a radiation control area. Please ask the department for radiation protection before starting your experiment.



32. Check if the administered radioactive substances are metabolised and exhausted. The amount of released gaseous radioactive material must be assessed.

33. Living animals which are treated with radioactive substances must be kept in special metabolism cages (Stoffwechselkäfige) which are available in the central animal laboratory (Zentrales Tierlabor) of the university.

34. Be aware that there is a high risk for contamination when removing organs or extracting blood.

35. Cage material must be measured and proclaimed free of radiation by the department for radiation protection before returning it.

36. Carcasses, straw and blood samples must be disposed by the department for radiation protection

#### **Cleaning of the floor in radioactive areas**

37. When the floor of an isotope laboratory is being cleaned by the personnel of the department or by a cleansing company the work has to be stopped.

38. The regulations of §15 StrlSchV are valid for the personnel of the outside cleansing company.

39. The department for radiation protection instructs the cleaning personnel of the university once a year, supplies them with official personal dosimeters and enrolls them for a radiation protection examination.

40. The foreign personnel receives their dosimeters from the radiation protection agent of the cleansing company. The department for radiation protection gives the instruction for the device once a year.

41. The laboratory personnel and the radiation protection agent take care that the cleaning personnel wear the official dosimeters and the appropriate protective clothing.

42. The radiation protection agents ensure that the ground floors which should be cleaned are not contaminated, that the exposure to radiation of the cleaning personnel is minimised (e. g. by shielding the radiation sources) and that radioactive substances will not be incorporated.

43. The radiation protection agents also monitor the floors and laboratories adjacent to the radioactive working area for contamination.

44. Pregnant cleaning ladies may neither work in the radiation control areas nor in the operational control areas.

45. The biological safety agent of the university defines and cares for all measures necessary for biological safety at work.

### **Shielding**

46. Appropriate shielding is necessary for the work with/or the storage of radioactive substances.

47. Commonly available plexiglass protective shields (thickness > 0.8 cm) are sufficient for working with  $^{14}\text{C}$ ,  $^{35}\text{S}$ ,  $^{32}\text{S}$ ,  $^{33}\text{P}$  and  $^{45}\text{Ca}$ .

48. Plexiglas protective shields doped with lead (also available via laboratory specialist suppliers) are useful for the work with radionuclides which emit gamma radiation (low energy emitter like  $^{125}\text{I}$ ). A lead shielding of at least 1 cm thickness protects against the 320 keV radiation of  $^{51}\text{Cr}$ .

### **Leaving the radioactive area (Isotopenbereich)/monitoring of hands, feet and clothing**

49. Before leaving the working place (especially after finishing the daily work) the working place and its close surroundings must be monitored for radioactive contamination.

50. Any contamination found must be reported to the radiation protection agent and removed or marked.

51. Take off the protective clothing and gloves before leaving the radioactive laboratory.

52. Before leaving the control area each employee has to use a hand-foot-clothing monitor (HFK-Monitor) or another control device. Hands and shoes are measured in any case.

53. The radiation protection agent and the department for radiation protection must be informed immediately about malfunctions of the hand-foot-clothing monitor (HFK-Monitor) such as defect Geiger counters or too much background radiation etc.

54. The costs for service and repair of a radiation meter or a hand-foot-clothing monitor (HFK-Monitor) lent by the department for radiation protection must be paid proportionally by the teams working in the control area.

55. Only in case of danger the radiation area (Isotopenbereich) may be left through the escape door (Fluchttür) by using the green door opener (Türwächter) or by removing the hood over the door handle (not valid for all buildings).

### **Dosimetry of persons**

56. The official measuring station for the university and the clinic is the **Forschungszentrum Karlsruhe, Messstelle für Festkörperdosimeter** (see appendix 8).

57. The radiation protection agents are responsible for the official dosimetry of persons with phosphate glass dosimeters (Phosphatglasdosimeter) and finger ring dosimeters (Fingerringdosimeter).

58. The monitoring interval (Überwachungszeitraum) is one month for all employees.

59. Use finger ring dosimeters (Fingerringdosimeter) when working with amounts of  $^{36}\text{Cl}$  or  $^{32}\text{P}$  higher than 200 MBq.

60. If exceptionally high expositions to radiation are detected the results of the official dosimetry of persons must be forwarded to the department for radiation protection.

61. Visitors or employees of external companies receive instantly readable dosimeters from the department for radiation protection.

### **Opening measurements (*Freigabemessungen*)**

62. Objects may only be removed out of the control area if they are completely harmless in concern of hygiene and virology and if they are (without any doubt) not contaminated by radioactive substances. This is ensured by opening measurements.

The radiation protection agent must confirm in writing that equipment that needs repairing is free of any contamination before the equipment is shipped or given to a workshop.

Non contaminated equipment must be marked with a “non radioactive” (Nicht radioaktiv!) sticker that contains the relevant date and the signature of the radiation protection agent.

63. Manual workers and service personnel may start their repair work in the radiation control areas “*Strahlenschutzbereiche*” (control areas “*Kontrollbereiche*” and operational control areas “*Betriebliche Überwachungsbereiche*”) only after the radiation protection agent has declared these working areas, pipes, washbasins etc. as free of contamination. Any source of radiation must be removed out of the working area.

64. Take care for encased sources of radiation: external standards in liquid scintillation counters (LSC) and  $^{63}\text{Ni}$  in electron capture detectors (ECD). They must be removed by employees of the department for radiation control before the LSC and ECD are transported or scrapped.

65. The department for radiation control will support the measurements and the opening procedure. The department for radiation control will charge for its materials.

### **Purchase and storage of radioactive substances**

66. Order forms for radioactive substances may only be signed by the radiation protection agents or by their deputies. **Ordering by telephone is not allowed!** Any order must be given in written form (letter or fax).

Any other form of acquisition (e. g. external standards in LSC or radioactive sources given free from other departments or external institutions) must be reported to the department for radiation protection **before** being made.

**Only** the radiation protection agents and their deputies may accept the delivery of radioactive substances!

67. The current amount of radioactive substances must be shown on the yellow signs (beside the doors of the laboratories). These signs must also show the names and the telephone numbers of the responsible radiation protection agents.

68. The **current amount of encased and open radioactive substances** must be reported every 6 months to the department for radiation control.

69. Radioactive substances may be stored only in authorized rooms and there only in lockable and shielded safes or refrigerators or deep freezers.

70. Radioactive substances which are not required for an actual experiment must be stored in a lockable refrigerator, deep freezer or safe.

Radioactive substances or encapsulated sources of radiation may not be stored with free access on tables or elsewhere in the laboratory outside the working hours.

71. When working with radioactive substances (from the delivery via the storage to the disposal) it must be ensured that they cannot be stolen or misused.

72. Measurements immediately after the receipt of new substances must ensure that they do not leak because of defect packaging and that there is no danger of contamination of persons, furnishings or public areas. Analogue examinations must be performed with stored substances and packaged disposals.

**Devices for retaining waste water containing radioactive isotopes  
(Isotopenabwasserrückhalteanlage) and prohibition of drainage of radioactive  
substances**

(Please remember that in building INF 282 partially different and additional internal instructions are valid!)

73. Laboratory sinks, some funnel basins and hand basins in the control areas must be connected to the device for retaining waste water containing radioactive isotopes.

74. Water-jet pumps may neither be used in control areas nor in operational control areas.

75. Cooling water may not be discharged into the device for retaining waste water containing radioactive isotopes. Electrically driven vacuum pumps or closed cooling cycles must be used.

76. The first and second washing water or rinse water used for the cleaning of contaminated laboratory equipment must be collected as liquid radioactive waste in the appropriate vessels and forwarded to the place where radioactive waste is accepted (Annahmestelle für radioaktive Abfälle).

77. Liquid radioactive waste, the coating of TLC plates, residues of chromatography and gels from electrophoresis may not be disposed into the device for retaining waste water. Disposing mud and contaminated water into the radioactive waste water system (Isotopenabwassernetz) will give rise to malfunctioning and complications within the retaining system.

78. Under certain circumstances all laboratories connected to the radioactive waste water system must be closed for a short time if the cleaning or repair work takes a longer period of time.

79. In departments or radioactive laboratories (e. g. all operational control areas) which are not connected to a device for retaining waste water containing radioactive isotopes all the washing and rinse water must be collected as liquid radioactive waste and given to the place where radioactive waste is accepted.

80. Take care to do not use too much water at the sinks and funnel basins.

#### **Iodine absorption device (Iodsorptionsfilteranlage)**

81. When working with radioactive substances no steps may be performed outside the iodine filter hood (Iodfilterdigestorium) which may lead to the emission of radioactive gases. The iodination chamber is aerated and de-aerated automatically.

82. No working steps which give rise to large amounts of water vapour may be performed in an iodination laboratory. Else the iodine absorption filters will be damaged.

83. The faultless function of the filter unit must be checked before starting experiments with volatile radioactive substances.

84. Any malfunctions of the iodine absorption device must be reported to the department for radiation protection at once.

85. The experiments must be stopped **at once** if malfunctions of the iodine absorption device occur during an experiment with gaseous radioactive substances. The control area must be left and the department for radiation protection must be reported immediately.

The same is valid when the power supply and the aeration fails (optical and acoustical alert). The emergency power will be switched on after about 10 sec.

86. If radioactive gases are released during an experiment (iodination, hydration etc.) this must be recorded in written form. These record books (Betriebsbücher) must be stored in the laboratories at places which are accessible for the department for radiation protection.

87. If the iodine sorption filters are not in use the switch should be turned to “overnight shutdown” (“Nachtbetrieb”). This prevents an unnecessary soiling of the filters.

### **Special hints for the work with enclosed radioactive substances**

88. Enclosed radioactive substances are used in the radiation protection areas of the University of Heidelberg only for uses that require official approval such as radiation test sources for the calibration of radiation measurement instruments, Mössbauer radiation sources, external standards in LSCs, for the development of detectors and for demonstrations in lectures, practical training and instructions.

89. The radiation protection agent draws up an instruction for radiation protection which contains among other things all security precautions needed for the manipulation of sources (installation and removal) and for the adjustment of the beam (Mössbauer spectroscopy)

90. The organisational measurements and the regulations for registration for ordering or acquisition of enclosed radioactive substances are the same as with open radioactive substances.

Please note that buying a liquid scintillation counter with an external standard option (dpm measurement) includes the acquisition of an enclosed radioactive substance. Don't forget to register the  $^3\text{H}$  and  $^{14}\text{C}$  standards delivered as LSC accessories.

91. We urgently recommend to exercise the manipulation of Mössbauer sources in a test without exposition to radiation.

92. Shielding should be used according to the radiation protection plan or the user specific instruction for radiation protection.

93. When not in use the radioactive sources must be stored in their protective casing. Theft and fire proof casings, cabinets and rooms must be used for the storage.

94. During the use of enclosed radioactive substances care must be taken that they don't get stolen and that no unauthorised persons may manipulate them.

95.  $^{93}\text{Ni}$  preparations encased in electron capture detectors (ECD) are open radioactive substances. The acquisition and use of ECDs requires official approval without exception.

96. Enclosed sources may never be manipulated with bare hands when they are taken out of their casing during use or maintenance, repairing or adjusting works. They may only be handled with tongs or other remote control devices. Finger ring dosimeters must be worn.

97. Before the manipulation or the adjustment of strong sources (e. g. Mössbauer sources) the local dose rate must be calculated and all protective measurements (according to the ALARA principle: **as low as reasonably achievable**) must be taken. The department for radiation protection will help You.

98. When performing Mössbauer spectroscopy: never let Your hands or other parts of Your body get into the beam.



99. Before the repair of equipment by scientific workshops or external firms the radioactive sources must be removed and stored in a way that these employees are not exposed to any radiation.

100. The radiation protection agent must arrange for the leak tests and the maintenance works stipulated by the supervisory authority in time. Copies of the test reports must be forwarded to the department for radiation protection.

101. If the encasing of an encased radioactive substance is suspected to be damaged or leaky it may no longer be used. The radiation protection agent and the department for radiation protection must be informed.

The radiation protection agent must arrange for a leak test performed by a specialist as soon as possible.

102. The department for radiation protection disposes exhausted sources.

103. LSC devices, gas chromatography devices with ECDs and other devices which contain enclosed radioactive substances may be scrapped only after their release by the department for radiation protection.

104. Leave the professional removal of radiation sources (external standards, ECDs etc.) to the employees of the department for radiation protection.

### **Instructions**

105. Employees who are exposed to radiation because of their job must be instructed by the radiation protection agent (“Unterweisung”) once a year (this replaces the instruction every half year (“Belehrung”) according to the ancient StrlSchV and RöV).

106. These instructions must be recorded in written form.

107. These instructions may be given with representatives of the department for radiation protection present who might add some actual or additional information.

108. Copies of the records of the annual instructions (jährliche Unterweisungen) must be forwarded to the department for radiation protection.

109. Foreign employees are instructed by the department for radiation protection.

Guests or short time visitors of the radiation areas are instructed by the agent for radiation protection.

### **Medical control**

111. Employees working in the radiation areas of the University are usually classified as persons who are exposed to radiation in their work – class B (beruflich strahlenexponierte Personen der Kategorie B). Nevertheless a first examination (before starting to work as a person exposed to radiation) and a final examination (when finishing to work as a person exposed to radiation) must be performed by a radiologist.

112. Appointments for radiological examinations should be directed to the department for radiation protection. Further examinations are ordered or performed by the company doctor (betriebsärztlicher Dienst).

113 The agents for radiation protection enrol pregnant employees for an examination by the radiologist.

114. The necessity for the monitoring of incorporation of each employee is assessed by the agents for radiation protection.

### **Prohibitions and limitations of work**

115 Experiments without the use of radioactive substances may not be performed in the operational control areas (betriebliche Überwachungsbereiche). This avoids an unnecessary exposition to radiation of the scientists (§6 der StrlSchV, "Vermeidung unnötiger Strahlenexposition und Dosisreduzierung").

116. Pregnant employees have to inform the agent for radiation protection at once about their pregnancy.

117. The work with radioactive substances is strictly forbidden for pregnant and nursing mothers and for young persons under 18 years of age.

118. Pregnant or nursing employees must be released from work with radioactive substances immediately after the diagnosis of the pregnancy. They may work neither in control areas (Kontrollbereiche) nor in operational control areas (Betriebliche Überwachungsbereiche).

119. Please note the further regulations (§ 37 StrlSchV) about the restrictions of stay for visitors, students and trainees.

### **Foreign employees**

120. Manual workers employed at the University or the clinic may only stay in the control area under the permanent control of the agent for radiation protection. The same is valid for foreign workers. They have to enrol at least 3 days before the start of their work at the department for radiation protection. There they get an instruction and a written confirmation with which they have to identify themselves before the agent for radiation protection.

121. Persons who are involved in repair, maintenance and installation works must be instructed (belehrt) and they must wear the prescribed safety clothes (gloves, coats, breathing masks) and a dosimeter.

122. The working areas of the manual workers must be measured free of radiation expansively.

### **Waste disposal**

123. The agents for radiation protection are responsible for the disposal of the regular radioactive waste and for the instruction of the engaged employees.

124. The radioactive waste must be sorted, collected and packaged according to the conditions for the acceptance of the ZENTRALBEREICH Neuenheimer Feld.

125. The institutes and clinical work groups within the THEORETIKUM and the institutions in the special buildings 350 (OMZ), 360 (HIP), 400 (Kopfclinik) and 410 (neue Medizinische

Klinik) in the Neuenheimer Feld hand over their waste on each workday to the delivery point (building INF 347, basement). They are only accepted during the hours of business (see appendix 6).

126. Waste from institutes outside of the THEORETIKUM and the special buildings in the Neuenheimer Feld are disposed every fortnight by the Zentralbereich Neuenheimer Feld.

127. Shipping containers for waste may only be stored inside the appropriate movable transport containers on their way to the delivery point (THEORETIKUM) or to the packing station (institutes outside the THEORETIKUM). These are Plexiglas boxes for beta emitter and lead covered wooden boxes for gamma emitter. The transportation is performed on the shortest way in the lower floor to the delivery point in building 347 (basement) or the packing station.

128. No infectious waste may be handed over to the delivery point. The waste material must be sterilised at room temperature with an appropriate liquid technique:

solid waste: treat > 6 h with lysoformin solution 5 % v/v

liquid waste: treat > 6 h with lysoformin solution, final concentration 5 % v/v

129. Radioactive waste may not be autoclaved because of the possible release of radioactive gases. There are special regulations for the biological safety laboratory of Heidelberg University in the building 344b in the Neuenheimer Feld.

130. The agents for radiation protection may not measure radioactive substances in order to give them free and they may not let them be disposed with the ordinary rubbish or through the canalisation. The supervisory authority will punish any offences with a fine.

131. The rubbish which was separated according to the valid waste law (Abfallrecht) should be packaged in black (remaining rubbish), yellow (recyclable rubbish) and green (paper rubbish) bin liners. This normal waste containers must be checked for radioactivity and given free by the agent for radiation protection before they are taken away by the room cleaners. The non contaminated bin liners get a release label with the date of the measurement and the signature of the radiation protection agent.

### **Conduct in case of contamination, accidents and other problems**

132. Please note the instructions about decontamination and the instructions in case of an alarm (see the notice board).

133. Take care that radioactive substances will not be spread into public areas.

134. In case of a small pollution the surfaces should be decontaminated at once (before liquids evaporate) e. g. with Deconex or other appropriate means. Try to do **not** enlarge the contaminated area.

135. If large areas get contaminated evacuate the corresponding region mark the contaminated area and inform the agent for radiation protection and the department for radiation protection immediately.

136. In case of injuries combined with contamination and incorporation the first aid and the treatment by a physician have the priority over the radiation protection (**internal emergency number: 4444 / regional rescue headquarters: 112**). Inform the agent for radiation protection and the department for radiation protection **immediately**.

137. In case of contamination of the skin please follow the instructions for decontamination (on the notice board) and inform the agent for radiation protection and the department for radiation protection immediately.

138. If the incorporation of radioactive substances is suspected the department for radiation protection must measure the urine immediately.

139. In case that splashes went into the eye call the internal emergency number 4444 immediately. Rinse the eyes with lots of water and thereby spread the eyelids with your fingers. Inform the radiation protection agent and the department for radiation protection.

140. All personal accidents in a radiation control area (control areas **and** operational control area) are followed by an investigation by the company doctor (radiologist).

141. The radiation protection agent and the department for radiation protection must be informed as soon as possible about all – even minor – accidents and malfunctions in radioactive laboratories.

142. The radiation protection agent and the department for radiation protection must also be informed as soon as possible about other problems, irregularities, possibility of contamination and incorporation and all other unusual incidents related to radioactive material.

143. Further information gives the leaflet “Erste Hilfe bei erhöhter Einwirkung ionisierender Strahlung” (GUV-1 668 from July 1999). This pdf-document can be acquired in the Internet: <http://www.uk-bw.de>

#### **End of work as radiation exposed employee**

144. The radiation protection agent must inform the department for radiation protection immediately about the end of work of a person professionally exposed to radiation.

145. Employees who end their service at the University of Heidelberg or at the University clinics receive a written confirmation about the dose accumulated in the radioactive areas of the University of Heidelberg or of the University clinics from the department for radiation protection.

146. The contract of employment with the University of Heidelberg or with the University clinic can only be cancelled after the arrival (at the personnel department) of the written confirmation about the accumulated dose of radiation and the written confirmation of the final physical examination by the company doctor.

#### **Appendix 1 Rules of conduct in case of an accident in the radioactive working area**

It is very important that any one employee in the radioactive working area reacts quickly and properly in case of an accident or a malfunction to prevent injuries and damages. We recommend the following actions:

1. In case of an emergency or an accident do everything that is necessary to secure other persons inside and outside of the radiation protection area
2. Remove further persons out of this area (in case of a probable contamination: measuring and decontamination if needed)
3. Block the contaminated area.
4. Inform the radiation protection agent and the department for radiation protection immediately.
5. If necessary call the fire brigade, telephone: 112.

Report as follows:

Where did it happen?	Exactly: town, street, house number, floor, room number, name of the institution
What happened?	e. g. radiation accident, laboratory accident
How many people are concerned/hurt?	number of casualties
Which sort of injuries?	e. g. critical condition, injuries etc. exposure to radiation (external, incorporated)
Who is reporting?	name, profession, proficiency in radiation protection

6. In case of life threatening conditions the assistance in the emergency has first priority:

\* apply first aid or artificial respiration (dangers to health like contamination will likely not arise) if necessary

\* contaminated injured persons should be decontaminated (see the instructions for decontamination) or at least the contaminated clothing should be removed and the injured persons should be wrapped and prepared for transport

\* contaminated material and clothing should be collected in plastic bags

\* contaminated surfaces should be decontaminated (see the instructions for decontamination) if necessary.

7. In case of an accident/malfunction please inform as quick as possible:

\* Zentrale Leitwarte Technik (ZLT, technical control centre) tel: 4444

\*Abteilung Strahlenschutz (department for radiation protection) tel: 54-4117  
54-379  
54-4104  
54-39183

Please use the addresses to contact in case an accident (see appendix 2)

## **Appendix 2 Addresses to contact in case of an accident at a radioactive place of work**

1. fire brigade telephone 112

red cross telephone 111

police telephone 110

2. Zentrale Leitwarte Technik  
(ZLT, technical control centre) telephone 4444

3. department for radiation protection telephone 54-4117, 54-4104 54-4109  
dect 56-32379, 56-39183  
56-32394, 56-32395  
mobile phone 0170-76220-31  
0170-76220-29



4. authorized representatives for radiation protection	telephone	54-8555, 54-4117, 54-8547
	dect	56-32379, 56-32381
	mobile phone	0170-76220-20
		0170-76220-31
		0170-76220-38
5. radiation protection agent(s)		see the notice in the laboratory
6. head of department		see the notice in the laboratory
7. next clinic with radiation protection equipment	telephone	56-8201, 56-8202
8. radiologist	telephone	56-8960, 56-8961, 56-8962
9. safety department	telephone	56-2168, 56-2166, 56-2165
10. GAA Mannheim	telephone	0621-292-4339/4301
11. biological safety agent	telephone	54-2340, 54-5510
12. in case of suspected incorporation	telephone	54-4117, 54-4104
	dect	56-32379, 56-39183
13. transport of hazardous materials	telephone	54-8542
	dect	56-32386

**Appendix 3    Weekly duties of a radioactive laboratory service  
(Friday to Friday)**

### *1. Daily routine check of the radioactive laboratory*

- Did all users of the radioactive laboratory sign the laboratory diary?
- Check the working places (tables, chairs, floors, cabinets etc.) for  $\beta$ - and  $\gamma$ -contamination with a portable radiation counter.
- are the laboratory tables cleared and clean?
- Wipe tests must be performed if the isotopes  $^3\text{H}$ ,  $^{35}\text{S}$  or  $^{14}\text{C}$  were used during the week.
- The responsible radiation protection agent must be informed in case of contamination. He is responsible for the immediate decontamination (the department for radiation protection of the ZENTRALBEREICH Neuenheimer Feld must also be informed).

### *2. Supply of the radioactive laboratory with consumables*

- protective foil for workbenches
- disposable gloves (sizes S, M, L)
- paper towels
- plastic pipettes
- pipette tips (blue and yellow)
- get hold of waste containers (available at the department for radiation protection)
- get hold of rubber latex bottles (6 to 10 litres) and AEA containers for long-lived waste. (available at the department for radiation protection)
- get hold of plastic bags (available at the department for radiation protection)

### *3. Check the waste in the non radioactive waste containers*

with a radiation counter. If no radiation can be measured the filled plastic bag is stored in the laboratory until the cleaning personnel will take it away. Shipping containers may never be stored on the corridor. The release note from the radiation protection agent must be clearly visible on the shipping container.

### *4. Check the batteries or the accumulators of the portable counters*

and recharge them if needed. Batteries are available in the department for electronics (Abteilung Elektronik) of the ZENTRALBEREICH Neuenheimer Feld. Chargers for the SEAG-counters are in the department for radiation protection.

### *5. Delivery of radioactive waste and the packaging*

Usually daily delivery according to the “conditions for the acceptance of radioactive waste” (see appendix 5 and appendix 6) via the department for radiation protection (see appendix 8).

Please check the following items for surface contaminations:

- the vessels for liquid waste
- the plastic bags for solid waste
- special waste (lead containers, glass, syringes)
- the Plexiglas or lead shielding of the original shipping containers
- the AEA container for long lived-waste
- the packaging from Amersham or from other companies (cardboard boxes and dry ice containers)

*6. Each Friday these responsibilities are handed over to the successor*

Make sure (in your own interest) that the laboratories are handed over clear and without contamination.

#### **Appendix 4 Instructions for the decontamination of a radioactive laboratory**

Even carefully planned and performed experiments with open radioactive substances may cause contamination. A purposeful decontamination will reduce the radiation in the relevant areas quickly.

##### *Performing and monitoring of decontaminations*

The purpose of any decontamination is to remove or reduce any measurable contamination.

Any radioactive laboratory should have decontamination solutions (e. g. Deconex or Countoff) at hand.

Use the yellow decontamination box (Dekontaminationskasten) available at the department for radiation protection if needed.

Write down the time of the contamination and of the start of the decontamination.

### *1. Decontamination of surfaces*

-Mark the contaminated surface and block the entrance.

-Put protective clothing on.

-Soak up the contaminated liquids immediately.

-Perform a check measurement of the contaminated surface.

-If needed decontaminate the surface as follows:

1. Clean the contaminated surface 2 – 3 times with liquid soap and a sponge. Perform a **check measurement afterwards**.

2. Clean the contaminated surface 2 – 3 times with decontamination paste or with moistened scouring powder or scouring milk (Scheuermilch). Perform a **check measurement afterwards**.

3. Clean the contaminated surface 2 – 3 times with scouring milk. Perform a **check measurement afterwards**.

4. Collect the rinsing water as radioactive waste!

### *2. Decontamination of rotors*

Never use Deconex TM to clean the rotors of centrifuges. Soak the rotor in a plastic basin filled with water and washing-up liquid instead. After a few hours incubation time rinse the rotor with water and collect the rinsing water as radioactive waste!

### *3. Decontamination of persons*

#### *3.1 General regulations*

Decontaminate as follows:

- block the residence of the contaminated person.

-take off the contaminated clothing and collect it in a plastic bag.

- Put protective clothing on if needed.

- Perform measurements of contamination in the residence of the contaminated person (the sanitary facilities as well).

- Perform further measurements of persons who were in contact with the contaminated person at the assumed time of the contamination.

- If a measure removes less than 10 % of the contamination then change it (scheme on page?).

- If the skin blushes or if it gets injured during or after a contamination of the skin, or if the decontamination measures are not successful then consult a physician.

- Collect the materials used for decontamination.
- Write down all steps of the decontamination.

### *3.2 Decontamination of uninjured skin*

Decontaminate the skin as follows:

- Decontaminate the skin as gently as possible
- Avoid the spreading of the contamination during all steps of the decontamination (local decontamination).
- Cover any liquid contamination with **cotton wool** (Zellstoff) in order to soak it.
- Washing the skin with neutral liquid soap (washing-up liquid may be used because it does not change the pH) is usually the first step of the decontamination. Rub gently with a plastic brush.
- If a decontamination removes less than 10 % of the radioactivity from the skin then change the method (see scheme on page ???).
- Rinse decontaminated areas of the skin with lukewarm water.
- Write down all steps of the decontamination.

### *3.3 Decontamination of wounds (first aid)*

The first action administered to a newly acquired wound (as a measure of first aid by the first helper on the spot) is to decontaminate it. **Medical care has priority** over all other actions.

Decontaminate as follows:

- The wound should be covered with sterile dressing material.
- All of the decontaminating and dressing material that came in contact with contaminated blood must be stored to identify the radioactive nuclides and to assess their activity.
- If the injured person must be moved measures against the **spreading of the contamination** must be taken (cover the contaminated person).
- Decontamination of wounds beyond the area of first aid must be performed by a capable physician.

### *3.4 Decontamination of individual parts of the body*

- The washing of **hairs** should be performed by a helper wearing gloves, using shampoo with the head bent back over a suitable washing basin. The contaminated water should not get into the face, the eyes and the ears. Cut the hair if needed.

- If the **eyes** are contaminated rinse them with lukewarm water from the inner to the outer side to avoid contamination of the tear duct.

-If the **auditory canal** is contaminated please consult a physician.

-If the **area of the mouth or the nose** is contaminated there is a chance of incorporation. Gargle with hydrogen peroxide and clean the teeth for the decontamination of the mouth.

- The **nose** may be cleaned by blowing.

- Collect the contaminated water as radioactive waste.

*Diagram for the decontamination of uninjured skin*

Wash locally with neutral soap or washing-up liquid

Repeat 2 – 3 times

Check the contamination

Positive

negative

Wash locally with a solution of a complexing agent

(a 1% solution of EDTA or DTPA, incubate for 2 – 3 minutes)

Use a potassium iodine solution in case of radioactive iodine compounds)

Repeat 2 – 3 times

Check the contamination

Positive

negative

Wash (rubbing gently) locally with a decontamination paste (e. g. Deconex)

Repeat 2 – 3 times

Check the contamination

Positive

negative

Wash locally with a 1 – 3% solution of citric acid or sodium citrate

(incubate for 2 minutes)

Repeat 2 – 3 times

Check the contamination

Positive

negative

Wash locally with newly prepared potassium permanganate solution

(65 g in 1 litre 1% H<sub>2</sub>SO<sub>4</sub>)

afterwards remove the manganese dioxide with the help of sodium bisulphite solution

(don't apply in the face)

Repeat twice

Check the contamination

Wash locally with water and neutral soap or washing-up liquid

Inform the radiation protection agent and the department for radiation protection

## **Appendix 5 Conditions for the acceptance of radioactive waste – THEORETIKUM**

### *General regulations for the disposal of radioactive waste*

The department for radiation protection in the ZENTRALBEREICH Neuenheimer Feld is responsible for the disposal of any radioactive waste from the university and clinics.

The departments and the workgroups of the THEORETIKUM and the University clinic and the departments in the special buildings 350 (OMZ), 360 (HIP), 400 (Kopfclinik) and 410 (neue medizinische Klinik) in the Neuenheimer Feld deliver their radioactive waste directly to the department for radiation protection.

The radioactive waste should be brought to the delivery point daily or at the latest when the designated shipping container is completely filled. This is not only valid for radioactive waste produced by experiments which require official approval (in the control areas, Kontrollbereiche). The waste produced in the operational control areas (betriebliche Überwachungsbereiche) must also be handed over to the department for radiation protection.

The delivery point for radioactive waste is in the basement of building 347, room U22. Radioactive waste is only accepted during the hours of business (see appendix 8).

### *Types of waste/sorting of waste by the users*

Radioactive waste is distinguished in short-lived (containing radioactive nuclides with a half-life < 110 days) and long-lived (half-life > 100 days) waste which may both be either liquid or solid.

The short-lived and long-lived radioactive waste must be collected separately because of their different physical and chemical properties and because of their further treatment. They should be separated in the following types of waste:

1. paper/ plastic/ glass/ metals
2. watery liquids
- 3<sub>1</sub>. plastic or glass vials with hardly inflammable residues of liquid scintillators (LSC waste which is biologically degradable)
- 3<sub>2</sub>. plastic or glass vials with highly flammable residues of liquid scintillators (LSC waste which are dangerous for health and environment, e. g. toluene, xylene, dioxane etc.)



4. flammable liquids (solvents, LSC mixtures)
5. carcasses of animals/ samples of organs and blood
6. straw/ droppings
7. contaminated shipping containers of the suppliers (e. g. plastic compartments of lead containers)
8. gauge
9. enclosed radioactive substances
10. Waste containing uranium, radium, thorium
11. ionisation smoke monitor
12. removed sources (e. g. external SC standards, ECDs)

Short-lived and long-lived waste may not be mixed as well as the above listed types of waste. Additionally the short-lived wastes must be sorted and packaged according to the type of nuclide, i. e. a shipping container for short-lived waste may only contain a single nuclide, e. g. waste that contains only  $^{32}\text{P}$  or only  $^{33}\text{P}$  or only  $^{35}\text{S}$  or only  $^{125}\text{I}$ .

Long-lived waste must be sorted in waste that contains  $^3\text{H}$  and waste that contains  $^{14}\text{C}$ . The other waste must be sorted according to the types given above.

Waste with other long-lived radioactive nuclides may be mixed if they are from the same type. A single shipping container for long-lived waste may e. g. contain:

- only watery liquids containing  $^3\text{H}$  or
- only solid waste (paper, plastic) containing  $^{14}\text{C}$  or
- only solid LSC waste containing  $^{57}\text{Co}$ ,  $^{113}\text{Sn}$ ,  $^{22}\text{Na}$ , and  $^{45}\text{Ca}$  or
- only carcasses of animals containing  $^{14}\text{C}$

Waste with high specific activity should not be mixed with waste with low specific activity if possible. Faulty mixing and packaging will cause higher costs for the disposal.

#### *Types of shipping containers/packaging of the waste by the users*

The table on page ??? gives the details about the packaging and the size of shipping containers of long-lived and short-lived waste.

#### *Empty packaging*

All non contaminated empty original packaging (cardboard boxes, dry ice containers, lead containers, tins) for radioactive substances from the companies Amersham-Buchler and NEN must be delivered to the delivery point during the hours of business. Doing this, please follow these regulations:

- radiation hazard signs on CDCs, cardboard boxes, polystyrene and lead containers must be removed or turned permanently unreadable.
- lead containers are only accepted inside of cardboard boxes or polystyrene containers.
- empty packaging – including the lead containers – must be free of contamination inside and outside.
- each cardboard box and each polystyrene container must be marked with a release label (Freigabe-Etikett). The old take over documents (Übernahmescheine) for empty packaging are no longer in use.

The following informations **must** be written on the label:

1. the writing “Keine Radioaktivität!” (no radioactivity)
2. the name of the department
3. the date of the handling over
4. the signature of the radiation protection agent

#### *Important tips for sorting and packaging of radioactive Waste*

The department for radiation protection has developed a method to measure the specific activity of the shipping containers for waste which is in use. So it is important that the bags and bottles correspond to this calibrated measuring geometry in volume, size and consistency. The minimal volume of a single container for solid and liquid short-lived waste is 5 litres, the maximal volume is 10 litres. The regulations for sorting and packaging given above must be strictly obeyed. An arrangement about smaller container volumes is possible in exceptional cases.

The volume of containers for animal carcasses is limited to 10 litres because of the above given reasons and because the relatively small feeding hatch of the incinerator. Bigger carcasses have to be carved up. The same is valid for samples of organs and of blood.

- The PE bottles may not be filled up to the rim. There must be at least a gap of 10 centimetres between the liquid and the cap. The same is valid for round bottom bags with solids.
- **Pointed and sharp-edged objects** (pipettes made of glass or plastic, razor blades, injection needles, broken glass) must be packaged first into stable cardboard boxes or wide neck PE bottles of a suitable size. These vessels are then added to the waste container.

- All waste containers must be tightly sealed (PE bags with tear proof adhesive tape; PE bottles with their appropriate screw caps).
- Waste containing uranium, radium and thorium can only be accepted in solid state. Liquid waste of this kind must be solidified by stirring them into calcified gypsum in PE vessels (maximal 10 litres). The volume expansion during the solidification must thereby be taken into account.
- **Infectious radioactive waste** will not be accepted. It must be sterilised. Waste containers which contain volatile radioactive substances may under no circumstances be autoclaved.
- The contamination of waste with radioactive substances and also with pathogens should be avoided whenever possible. If an experiment requires such a double contamination then the waste must be sterilised chemically.
- The sterilisation method can be discussed with experts, such as Dr. Roland Kehm (dept. of biotechnology of the ZENTRALBEREICH Neuenheimer Feld) or Dr. Willi Siller (biological safety agent of the University).
- Sterilised waste and the method of sterilisation must be declared when handing it over.
- In rare exceptional cases and in case of special waste disposal (residual pollution removal, Altlastenbeseitigung) other regulations for sorting and packaging may be arranged with the department for radiation protection.
- The party responsible for the waste must check the packaging for damages before filling in the waste. This is of special importance for reusable PE bottles used for radioactive liquids.
- The outer surface of all packaging (PE bottles, PE bags, AM containers) must be free of contamination.

Bottles with liquid radioactive waste should (in radioactive laboratories) be stored in waterproof dishes or containers until they are taken away.

The radioactive waste (in radioactive laboratories) is stored behind an appropriate shielding until its usually daily removal. Tips for this can be obtained from the department for radiation protection.

#### *Transport of radioactive waste to the delivery point*

The radioactive waste must be transported (in waterproof containers which can be decontaminated) on the shortest possible way to the delivery point via the **goods lifts** and the **basement corridors**. Employees in the special building 410 (neue medizinische Klinik) in the Neuenheimer Feld get via the **connecting bridge** to the THEORETIKUM. If possible no

protective gloves should be worn during the transport. The transport containers (cards, boxes etc.) must be free of contamination inside and outside.

Radioactive waste may never be parked without a guard. Suitable materials for the transport containers are:

- for  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{33}\text{P}$ ,  $^{35}\text{S}$ : metal containers, aluminium containers, Plexiglas boxes
- for  $^{32}\text{P}$ ,  $^{36}\text{Cl}$ ,  $^{45}\text{Ca}$ : Plexiglas boxes, (minimally 15 mm for  $^{32}\text{P}$  and  $^{36}\text{Cl}$ )
- $^{125}\text{I}$ : wooden box coated with 3 mm lead
- $^{57}\text{Co}$ ,  $^{99\text{m}}\text{Tc}$ ,  $^{123}\text{I}$ : wooden box coated with 8 mm lead
- $^{22}\text{Na}$ ,  $^{46}\text{Sc}$ ,  $^{51}\text{Cr}$  and  
 $^{85}\text{Sr}$ ,  $^{111}\text{In}$ ,  $^{113}\text{Sn}$ ,  $^{131}\text{I}$ : wooden box coated with 10 mm lead

### *Labelling of radioactive waste*

A label must be attached to all containers (10 litres PE round bottom bags, 10 litres PE bottles) containing short-lived waste. This labels must contain the following data:

1. the date
2. the radioactive nuclide
3. the estimated activity in MBq
4. the number of the customer card
5. the name of the radiation protection agent

### *Document of acceptance(take over) for radioactive waste (Übernahmeschein)*

The document of acceptance for radioactive waste must be completely, permanently and well readable filled in. It must contain the information about the radioactive nuclides involved, about the working place, about the approval of work and the telephone number of the person responsible for the waste. Each waste container needs its own document of acceptance.

### *Customer card (Kundenkarte)*

When handing over radioactive waste a customer card (Kundenkarte, Auftragsberechtigungskarte) must be shown.

### *Sources of supply*

These items may be purchased at the following departments of the ZENTRALBEREICH Neuenheimer Feld when showing a customer card:

- department for radiation protection      5 litre /12 litre/ 50 litre PE bottles

Amersham containers  
lead containers  
3 mm lead foil  
20 litre pedal bin for radioactive waste  
several sorts of transport containers  
cardboard boxes  
documents of acceptance for radioactive waste

- central store room

10 litre PE round bottom bags  
grey and black plastic bags

department for precision engineering

Plexiglas, lead foil, wooden boxes  
0.5/ 1 litre PE wide neck bottles (for injection  
needles, broken glass, scalpels), adhesive tape

*Charges for the acceptance for radioactive waste*

The handing over of radioactive waste costs as follows (see the circular of the radiation protection agent from September 11<sup>th</sup> 1991):

- short-lived radioactive waste

(half-time < 100 days), solid or liquid 61 cents/ litre

- short-lived radioactive marked carcasses

of animals and samples of organs and blood 102 cents/litre

-long-lived radioactive waste

(half-time > 100 days), solid, liquid and carcasses 48 cents/litre

- storage costs for short-lived radioactive waste 0.6 cents/litre, month

**The department for radiation protection accepts only radioactive waste that is sorted, packaged and declared according to the regulations above.**

	short-lived radioactive waste (half-time < 100d)	long-lived radioactive waste (half-time > 100d)
radioactive nuclides to be separated	P-32/P-33/S35/Cr-51/Fe-59/Sr-85/Tc-99m/ In-111/I-123/I-125/i-131	H-3/C-14//mixtures of all other long-lived nuclides (except $\gamma$ emitter, uranium, radium) e.g. Na-22/Cl-36/Ca-45/Co-57/ Sn-113
appropriate shielding for the transport to the delivery point	15 mm Plexi/10 mm Plexi/10 mm Plexi/ 10 mm Plexi/20 mm lead/10 mm lead/ 10 mm lead/8 mm lead/10 mm lead/ 8mm lead/3 mm lead/10 mm lead/	aluminium box, -case, metal bucket/ 10 mm Plexi, aluminium box, -case//10 mm lead (Na-22, Sn-113), 8 mm lead (Co-57), 10 mm Plexi (Cl-36, Ca-45)
1. paper/ plastic/ metals	colourless 10 litres PE round bottom bags (twice)	colourless 10 litres PE round bottom bags (twice)
2. watery liquids	5, 10, 12 litres PE bottles (Kautex bottles)	10, 40 litres metal containers with PE compartments (Amersham RAB010C/RAB040A)
3 <sub>1</sub> . LSC waste (vials)	colourless 10 litres PE round bottom bags (twice)	25 litres metal container with PE bag inside (Amersham RAB025L)
3 <sub>2</sub> . LSC waste (vials)	25 litres Amersham RAB025L with PE bag inside	25 litres metal container with PE bag inside (Amersham RAB025L)
4. flammable liquids (solvents, LSC mixtures)	5 litres, 60 litres metal container (Amersham RAB005N, RAB060P)	5 litres, 60 litres metal container (Amersham RAB005N, RAB060P)
5. carcasses of animals/ samples of organs and blood	grey 10 litres PE plastic bags (twice)	black 10 litres PE plastic bags (twice)
6. straw/ droppings	colourless 10 litres PE round bottom bags (one)	colourless 10 litres PE round bottom bags (one)
7. contaminated shipping containers of the suppliers	colourless 10 litres PE round bottom bags (twice)	colourless 10 litres PE round bottom bags (twice)
8. gauge	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement
9. enclosed radioactive substances	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement
10. Waste containing uranium uranyl acetate)	---	1, 2, 5, 10 litres PE bottles (gypsum) colourless 10 litres PE round bottom bags (paper, plastic)

## **Appendix 6 Conditions for the acceptance of radioactive waste – externally**

### *General regulations for the disposal of radioactive waste*

The department for radiation protection in the ZENTRALBEREICH Neuenheimer Feld is responsible for the disposal of any radioactive waste from the university and clinics.

The radioactive waste from the radiation protection areas I and II (Strahlenschutzbereiche I und II) outside of the THEORETIKUM is picked up with the lorry of the ZENTRALBEREICH Neuenheimer Feld regularly at every 1<sup>st</sup> and 3<sup>rd</sup> Tuesday a month.

This is not only valid for radioactive waste produced by experiments which require official approval (in the control areas, Kontrollbereiche). The waste produced in the operational control areas (betriebliche Überwachungsbereiche) must also be handed over to the department for radiation protection.

The need for picking up the waste must be announced at the department for radiation protection per fax (fax numbers: see appendix 8) at latest on Friday 12 o' clock for the following week, else the lorry won't come.

Waste is picked up only if it is sorted into the specified transport containers (see: "Types of shipping containers/packaging of the waste by the users" on page ???). The transport containers must be present at the loading site at the day of the pick up.

### *Types of waste/sorting of waste by the users*

Radioactive waste is distinguished in short-lived (containing radioactive nuclides with a half-life < 110 days) and long-lived (half-life > 100 days) waste which may both be either liquid or solid.

The short-lived and long-lived radioactive waste must be collected separately because of their different physical and chemical properties and because of their further treatment. They should be separated in the following types of waste:

1. paper/ plastic/ glass/ metals
2. watery liquids
3. plastic or glass vials with hardly inflammable residues of liquid scintillators (LSC waste which is biologically degradable)

3. plastic or glass vials with highly flammable residues of liquid scintillators (LSC waste which are dangerous for health and environment, e. g. toluene, xylene, dioxane etc.)
4. flammable liquids (solvents, LSC mixtures)
5. carcasses of animals/ samples of organs and blood
6. straw/ droppings
7. contaminated shipping containers of the suppliers (e. g. plastic compartments of lead containers)
8. gauge
9. enclosed radioactive substances
10. Waste containing uranium, radium, thorium
11. ionisation smoke monitor
12. removed sources (e. g. external SC standards, ECDs)

Short-lived and long-lived waste may not be mixed as well as the above listed types of waste. Additionally the short-lived wastes must be sorted and packaged according to the type of nuclide, i. e. a shipping container for short-lived waste may only contain a single nuclide, e. g. waste that contains only  $^{32}\text{P}$  or only  $^{33}\text{P}$  or only  $^{35}\text{S}$  or only  $^{125}\text{I}$ .

Long-lived waste must be sorted in waste that contains  $^3\text{H}$  and waste that contains  $^{14}\text{C}$ . The other waste must be sorted according to the types given above.

Waste with other long-lived radioactive nuclides may be mixed if they are from the same type. A single shipping container for long-lived waste may e. g. contain:

- only watery liquids containing  $^3\text{H}$  or
- only solid waste (paper, plastic) containing  $^{14}\text{C}$  or
- only solid LSC waste containing  $^{57}\text{Co}$ ,  $^{113}\text{Sn}$ ,  $^{22}\text{Na}$ , and  $^{45}\text{Ca}$  or
- only carcasses of animals containing  $^{14}\text{C}$

Waste with high specific activity should not be mixed with waste with low specific activity if possible. Faulty mixing and packaging will cause higher costs for the disposal.

#### *Types of shipping containers/packaging of the waste by the users*

To be transported by lorry the single waste containers must be packaged into authorised (according to ADR/GGVS) transport containers.



The table on page ??? gives the details about the packaging and the size of shipping containers of long-lived and short-lived waste.

#### *Important tips for sorting and packaging of radioactive Waste*

The department for radiation protection has developed a method to measure the specific activity of the shipping containers for waste which is in use. So it is important that the bags and bottles correspond to this calibrated measuring geometry in volume, size and consistency. The minimal volume of a single container for solid and liquid short-lived waste is 5 litres, the maximal volume is 10 litres. The regulations for sorting and packaging given above must be strictly obeyed. An arrangement about smaller container volumes is possible in exceptional cases.

The volume of containers for animal carcasses is limited to 10 litres because of the above given reasons and because the relatively small feeding hatch of the incinerator. Bigger carcasses have to be carved up. The same is valid for samples of organs and of blood.

- The PE bottles may not be filled up to the rim. There must be at least a gap of 10 centimetres between the liquid and the cap. The same is valid for round bottom bags with solids.

- **Pointed and sharp-edged objects** (pipettes made of glass or plastic, razor blades, injection needles, broken glass) must be packaged first into stable cardboard boxes or wide neck PE bottles of a suitable size. These vessels are then added to the waste container.

- All waste containers must be tightly sealed (PE bags with tear proof adhesive tape; PE bottles with their appropriate screw caps).

- Waste containing uranium, radium and thorium can only be accepted in solid state. Liquid waste of this kind must be solidified by stirring them into calcified gypsum in PE vessels (maximal 10 litres). The volume expansion during the solidification must thereby be taken into account.

- **Infectious radioactive waste** will not be accepted. It must be sterilised. Waste containers which contain volatile radioactive substances may under no circumstances be autoclaved.

- The contamination of waste with radioactive substances and also with pathogens should be avoided whenever possible. If an experiment requires such a double contamination then the waste must be sterilised chemically.

- The sterilisation method can be discussed with experts, such as Dr. Willi Siller (biological safety agent of the University).

- Sterilised waste and the method of sterilisation must be declared when handing it over.

- In rare exceptional cases and in case of special waste disposal (residual pollution removal, Altlastenbeseitigung) other regulations for sorting and packaging may be arranged with the department for radiation protection.
- Lead clad (5 mm) transport containers are available for radioactive waste containing high-energy  $\gamma$  emitters (with photon energies  $> 0.5$  MeV, e. g.  $^{60}\text{Co}$  or  $^{22}\text{Na}$ ).
- The party responsible for the waste must check the packaging for damages before filling in the waste. This is of special importance for reusable PE bottles used for radioactive liquids.
- The outer surfaces of the shipping containers **and** of the waste containers inside of them must be free of any contamination. The radiation protection agent of the producer of the waste certifies (on the transport papers and on the announcement form - fax) that the containers are free of contamination. The radiation protection agent of the producer of the waste measures the dose rate directly at the surface of the shipping container and in 1 metre distance and puts it down on the transport papers and on the announcement form - fax. Tips for this will be given by the employees of the department for radiation protection.

#### *Labelling of radioactive waste*

A label must be attached to all containers (10 litres PE round bottom bags, 10 litres PE bottles) containing short-lived waste. This labels must contain the following data:

1. the date
2. the radioactive nuclide
3. the estimated activity in MBq
4. the number of the customer card
5. the name of the radiation protection agent

#### *Document of acceptance(take over) for radioactive waste (Übernahmeschein)*

The document of acceptance for radioactive waste must be completely, permanently and well readable filled in. It must contain the information about the radioactive nuclides involved, about the working place, about the approval of work and the telephone number of the person responsible for the waste. Each waste container needs its own document of acceptance.

#### *Customer card (Kundenkarte)*

When handing over radioactive waste a customer card (Kundenkarte, Auftragsberechtigungskarte) must be shown.

*Sources of supply*

These items may be purchased at the following departments of the ZENTRALBEREICH Neuenheimer Feld when showing a customer card:

- department for radiation protection                      R 200 drums (recycled)  
   Amersham containers (recycled)  
   Amersham lead drums  
   documents of acceptance for radioactive waste  
   announcement forms (fax forms)
  
- central store room    10 litre PE round bottom bags  
   grey and black plastic bags (PE)  
   0.5/ 1 litre PE wide neck bottles (for injection  
   needles, broken glass, scalpels), adhesive tape

*Charges for the acceptance for radioactive waste*

The handing over of radioactive waste costs as follows:

- short-lived radioactive waste  
(half-time < 100 days), solid or liquid                                      61 cents/ litre
- short-lived radioactive marked carcasses  
of animals and samples of organs and blood                                      102 cents/litre
- long-lived radioactive waste  
(half-time > 100 days), solid, liquid and carcasses                                      48 cents/litre
- storage costs for short-lived radioactive waste                                      0.6 cents/litre, month
- costs of transport (only outside the clinics)                                      17.8 cents/kg

**The department for radiation protection accepts only radioactive waste that is sorted, packaged and declared according to the regulations above.**

	short-lived radioactive waste (half-time < 100d)	long-lived radioactive waste (half-time > 100d)
radioactive nuclides to be separated	P-32/P-33/S35/Cr-51/Fe-59/Sr-85/Tc-99m/ In-111/I-123/I-125/I-131	H-3/C-14//mixtures of all other long-lived nuclides (except $\gamma$ emitter, uranium, radium) e.g. Na-22/Cl-36/Ca-45/Co-57/ Sn-113
appropriate shielding for the transport to the delivery point	15 mm Plexi/10 mm Plexi/10 mm Plexi/ 10 mm Plexi/20 mm lead/10 mm lead/ 10 mm lead/8 mm lead/10 mm lead/ 8mm lead/3 mm lead/10 mm lead/	aluminium box, -case, metal bucket/ 10 mm Plexi, aluminium box, -case//10 mm lead (Na-22, Sn-113), 8 mm lead (Co-57), 10 mm Plexi (Cl-36, Ca-45)
1. paper/ plastic/ metals	colourless 10 litres PE round bottom bags (twice)	colourless 10 litres PE round bottom bags (twice)
2. watery liquids	5, 10, 12 litres PE bottles (Kautex bottles)	10, 40 litres metal containers with PE compartments (Amersham RAB010C/RAB040A)
3 <sub>1</sub> . LSC waste (vials)	colourless 10 litres PE round bottom bags (twice)	25 litres metal container with PE bag inside (Amersham RAB025L)
3 <sub>2</sub> . LSC waste (vials)	25 litres Amersham RAB025L with PE bag inside	25 litres metal container with PE bag inside (Amersham RAB025L)
4. flammable liquids (solvents, LSC mixtures)	5 litres, 60 litres metal container (Amersham RAB005N, RAB060P)	5 litres, 60 litres metal container (Amersham RAB005N, RAB060P)
5. carcasses of animals/ samples of organs and blood	grey 10 litres PE plastic bags (twice)	black 10 litres PE plastic bags (twice)
6. straw/ droppings	colourless 10 litres PE round bottom bags (one)	colourless 10 litres PE round bottom bags (one)
7. contaminated shipping containers of the suppliers	colourless 10 litres PE round bottom bags (twice)	colourless 10 litres PE round bottom bags (twice)
8. gauge	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement
9. enclosed radioactive substances	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement	lead containers, aluminium cans metal cans, PE wide neck bottles according to arrangement
10. Waste containing uranium uranyl acetate)	---	1, 2, 5, 10 litres PE bottles (gypsum) colourless 10 litres PE round bottom bags (paper, plastic)

**Appendix 7 Reports and applications to the department for radiation protection  
of the ZENTRALBEREICH Neuenheimer Feld  
of the University of Heidelberg**

- \* report about the stock of radioactive substances twice a year
- \* instruction according to §38 StrlSchV.
- \* registration for the first / final examination for radiation protection
- \* report on the entry / exit of an employee professionally exposed to radiation
- \* inquiry sheet of the radiation protection agent and his deputy
- \* inquiry sheet of employees professionally exposed to radiation
- \* report about contamination (persons and objects)
- \* report of accidents and malfunctions
- \* need of measuring an incorporation (urine)
- \* malfunctions of the iodine absorption device
- \* report on damages caused by water
- \*substantial changes in the stock of radioactive substances
- \* ordering of radioactive substances
- \* applications for changes in the authorisation process (rooms, working amount, storage amount)
- \* report on special events (accidents, malfunctions, contamination, aeration problems, loss of radioactive substances, suspected incorporation of radioactive substances, malfunctions of radiation meters).

**Appendix 8 Important addresses for radioactive laboratories**

