

Instructions for Radiation Protection

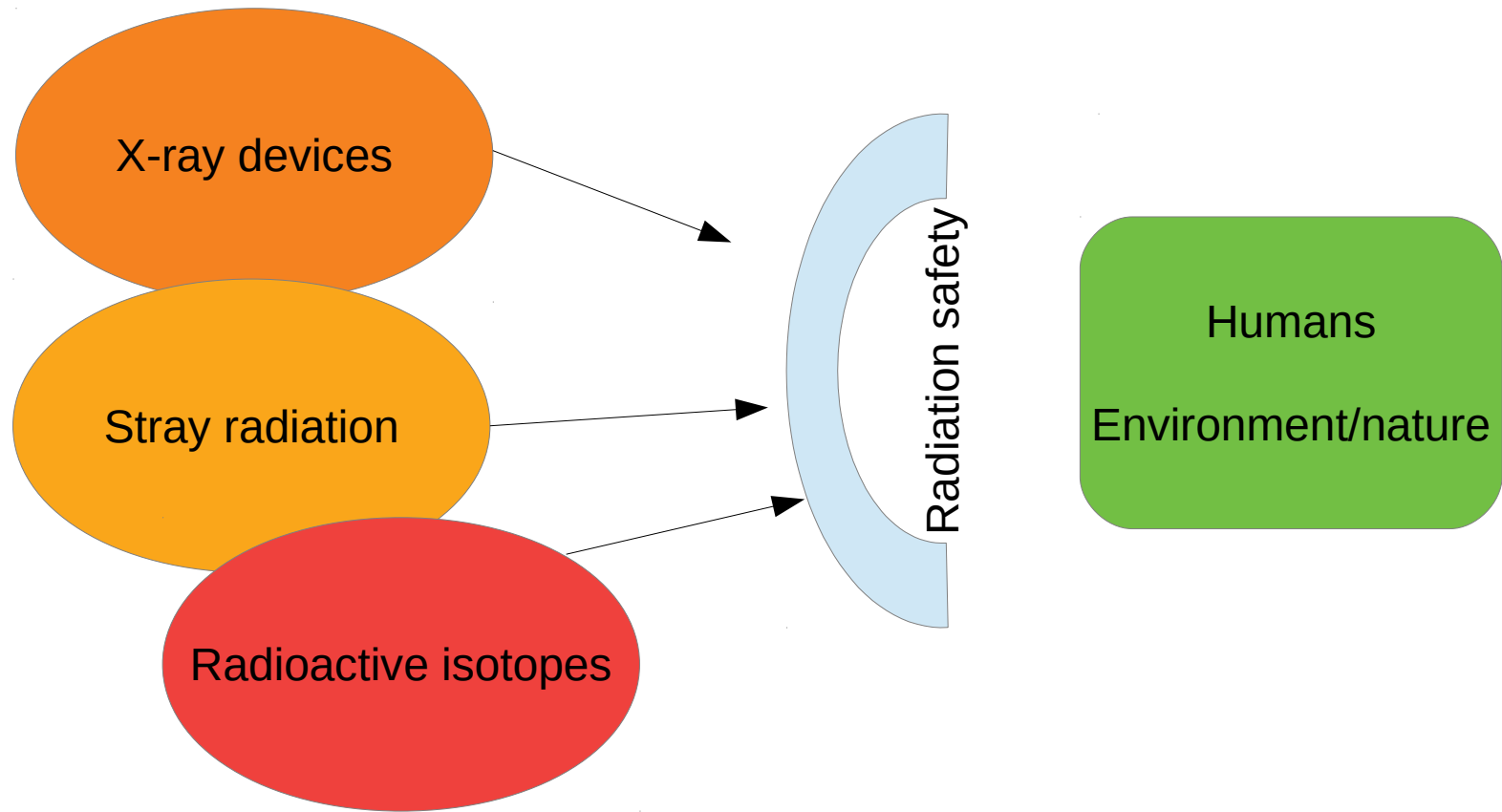
Strahlenschutzunterweisung nach
§63 StrlSchV (Strahlenschutzverordnung, 2018)

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Lawtext: https://www.gesetze-im-internet.de/strlschv_2018/



Radiation protection



Guidelines

- “Strahlenschutzverordnung” (President, UHH)
- “Sicherheitsordnung” incl. Section “H. Strahlenschutz”
- “Betriebsanweisungen” / Code of practice
- “Strahlenschutzanweisungen” / Code of practice
 - Radiation passport (HH RA 31/06)
 - Radioactive materials (HH RA 42/17)
- “Merkblätter” / Handout-Memos
Emergency plan (Alarmierungsplan)
- AGUM System:
safety (including radiation safety) relevant information stored centrally on University web site.

uni-hamburg.agu-hochschulen.de

www.desy.de/~tluczyn/Strahlenschutz

Code of Practice

Date: 23 June 2015

Scope:

Valid for:

Signature:

Handling radioactive materials

All persons in the rooms of the Institute of Experimental Physics

DESIGNATION

Radioactive preparations

General code of practice for handling and storing radioactive preparations

RISK TO PERSONNEL AND THE ENVIRONMENT



- The effects of large doses (> 1 Sv) of ionizing radiation on human beings can include acute deterministic radiation damage (burns, organ damage, radiation disease, death). Small doses of radiation can cause stochastic radiation damage (carcinomas, leukemia, genetic damage).

SAFETY MEASURES AND CODE OF CONDUCT



- Radioactive materials are to be handled exclusively for work-related purposes.
- The basic radiation safety rules apply: justification of their use (minimization of activity), minimization of the exposure time, maximization of the distance to the source, optimization of the shielding.
- The following regulations apply: German Radiation Protection Ordinance (Strahlenschutzverordnung, StrlSchV; see Foyer Building 67 or Internet), the radiation protection regulations issued by the president of the University, and section "H" of the Safety Regulations (Strahlenschutzanweisung) of the Institute of Experimental Physics.
- All persons exposed to radiation must be briefed by the radiation safety officer. Attendance of yearly radiation safety briefings is mandatory.
- Transport of radioactive materials on the DESY campus is allowed exclusively with the agreement of the radiation safety officer.
- Transport of radioactive materials outside the DESY campus is subject to the German Road Transport Regulations (Straßenverkehrsordnung, StVO) and may only be arranged by the radiation safety officer.
- Radioactive materials must be stored in well-shielded, lockable cabinets (safes). In addition to the safes in the main storage room for radioactive materials, safes are also available in the laboratories in order to minimize exposure during transportation.
- Radioactive substances are issued exclusively by the radiation safety officer for work purposes. The recipient must sign them out, and the radiation safety officer must confirm their receipt with signature and date.
- The procurement of radioactive materials can only be arranged via the radiation safety officer.
- In controlled areas (radiation dose in excess of 6 mSv but less than 20 mSv per year), official personal dosimetric monitoring must be carried out. Even if the radiation dose per year expected is lower, official personal dosimetric monitoring can be requested.
- Enclosed radioactive substances above a certain level of activity must undergo an official yearly inspection (StrlSchV). When this inspection is to be carried out, the sources must be handed over to the radiation safety officer.
- Radiation protection equipment (shielding, transport containers) must not be modified!
- Unborn children deserve special protection. Corresponding safety measures can only be implemented if the radiation safety officer has been informed about the pregnancy.

WHAT TO DO IN THE EVENT OF ACCIDENTS: EMERGENCY NUMBER EXT. 2500



- In the event of malfunctions or accidents (e.g., a high level of radiation exposure, contamination of persons or rooms, damage or loss of radioactive chemical preparations and fire), inform the radiation safety officer, staff, and the supervisor.
- In the event of incipient fires: fight the fire if this is possible without putting yourself at risk. Every fire must be reported to the Technical Emergency Service, (ext. 6565).



- In the event of more serious incidents: dial emergency number ext. 2600.
- Evacuate persons from the hazardous area without putting yourself at risk.
- Treat minor injuries using the first aid kit (enter the details in the logbook).
- Inform the radiation safety officer and first aid officers.
- List of emergency doctors: <http://www.web.dguv.de/dguv/Lv/Web/foes/D>

CONSEQUENCES OF NON-COMPLIANCE

- Health consequences: injuries and sickness
- Disciplinary consequences: written warning

Code of Practice

Date: 23 June 2015

Scope:

Valid for:

Signature:

Working with X-ray equipment and stray radiation emitters

Employees in the buildings of the Institute of Experimental Physics

DESIGNATION

Equipment for the generation of ionizing radiation and stray radiation emitters

General code of practice for the use of X-ray equipment and stray radiation emitters

RISKS TO PERSONNEL AND THE ENVIRONMENT



- The effects of large doses (> 1 Sv) of ionizing radiation on human beings can include acute deterministic radiation damage (burns, organ damage, radiation disease, death). Small doses of radiation can cause stochastic radiation damage (carcinomas, leukemia, genetic damage).
- Equipment uses high voltage. Please refer to the Code of Practice: Electricity.



SAFETY MEASURES AND CODE OF CONDUCT



- Operating instructions for the X-ray equipment must be observed.
- The following regulations apply: German X-ray Ordinance (Röntgenverordnung, RÖV, see notice in Building 67 or Internet), the radiation protection regulations issued by the president of the University, and section "H" of the safety regulations (Strahlenschutzanweisung) of the Institute of Experimental Physics.
- Persons working with ionizing radiation must be briefed by the radiation safety officer. Participation in the annual briefing is obligatory.
- Technical briefings must be provided by the group leader or the leading experimentalist. These are also required for operating the system.
- Safety devices must be visually inspected before switching on the equipment and must not be removed or bypassed.
- Structural modifications of any kind to the X-ray tubes are not permitted.
- Positional changes during the experiment and swapping devices between experiments are only permitted with the agreement of the radiation safety officer.
- The operating time of a system should be limited (switch on only when necessary!).
- The operating time is to be documented in a logbook (Betriebsbuch).
- In controlled areas (radiation dose in excess of 6 mSv but less than 20 mSv per year), official personal dosimetric monitoring must be carried out. Even if the radiation dose per year expected is lower, official personal dosimetric monitoring can be requested.
- Radiation protection equipment (shielding, transport containers) must not be modified!
- Unborn children deserve special protection. Corresponding safety measures can only be implemented if the radiation safety officer has been informed about the pregnancy.

WHAT TO DO IN THE EVENT OF MALFUNCTIONS



- In the event of malfunction of the experiment stop the experiment and activate emergency stop.
- Inform other members of staff and the supervisor.
- If the X-ray equipment malfunctions, inform the radiation safety officer.
- In the event of incipient fires: fight the fire if this is possible without putting yourself at risk. Every fire must be reported to the Technical Emergency Service, (ext. 6565).
- In the event of more serious incidents: dial emergency number ext. 2600.

WHAT TO DO IN THE EVENT OF ACCIDENTS: EMERGENCY NUMBER EXT. 2500



- Evacuate persons from the hazardous area without putting yourself at risk.
- Contact the Technical Emergency Service: emergency number ext. 2600.
- Treat minor injuries using the first aid kit and enter the details in the logbook (Verbandsbuch).
- Inform trained first-aid officers and the radiation safety officer.
- List of emergency doctors: <http://www.web.dguv.de/dguv/Lv/Web/foes/D>

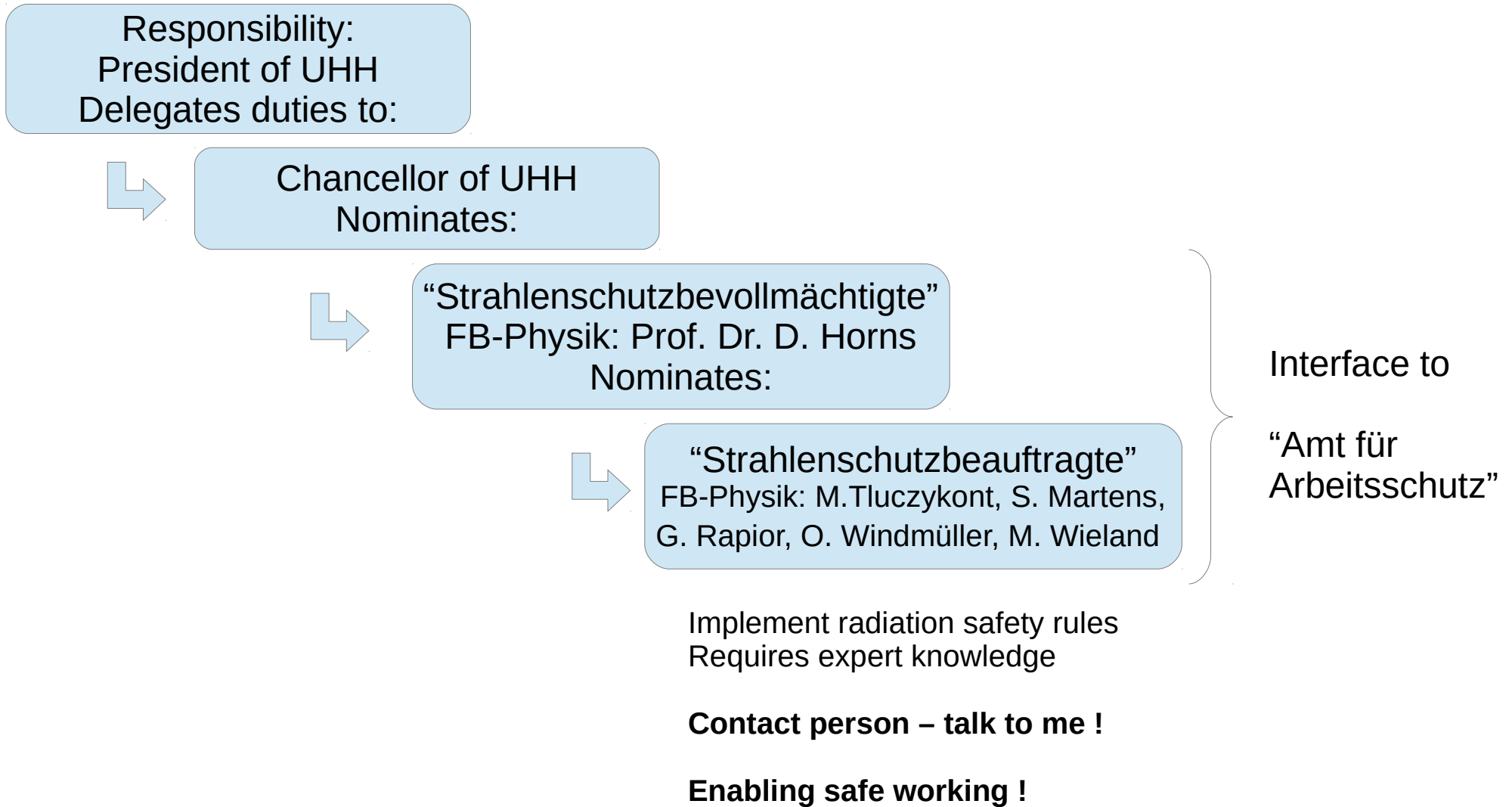
MAINTENANCE

- Before using a machine, always check its function and safety mechanisms!
- Maintenance and repair must be only be carried out by trained specialist staff!
- The equipment must undergo a technical inspection at 5-year intervals.

CONSEQUENCES OF NON-COMPLIANCE

- Health consequences: injuries and sickness
- Disciplinary consequences: written warning

Organisation



Organisation of radiation protection

- **Strahlenschutzbeauftragte at InstExpPh:**

Name	Type	Bahrenfeld	Vorlesungs- vorbereitung	Mediziner- praktikum	Dosimetrie / Strahlenpässe (Fremde Anlagen)
Gerald Rapior	StrlSchV		✓		
Stephan Martens	StrlSchV	✓			
Marek Wieland	RöV	✓			
Ole Windmüller	StrlSchV RöV			✓	
Martin Tluczykont	StrlSchV RöV	✓	✓	✓	✓

+ INF (M. Langer, K. Groth)
+ ILP (U. Pape, F. Holweg)
+ DESY (M. Salmani, +D3)

Radiation at the Institute for Experimental Physics

HH-RA 42/17



Radioactive materials:

- stored in safes at different locations
- can be used in experiments

Radiation at the Institut für Experimentelle Physik

HH-RA 42/17



Radioactive materials:

- stored in safes at different locations
- can be used in experiments



Kobalt 60						
27Co060/01	245	kBq	04.02.74	1.1	kBq	19.11.14 21.10.14 A
27Co060/02	295	kBq	06.03.74	1.4	kBq	19.11.14 21.10.14 A
27Co060/04	70	kBq	09.02.73	0.3	kBq	19.11.14 21.10.14 A
27Co060/05	3700	kBq	27.12.83	63.6	kBq	19.11.14 09.10.14 F
27Co060/06	389	kBq	01.04.79	3.0	kBq	19.11.14 09.10.14 F
27Co060/10	91800	kBq	25.12.98	11339.5	kBq	19.11.14 21.10.14 A
27Co060/11	87000	kBq	25.12.98	10746.5	kBq	19.11.14 21.10.14 A
27Co060/12	3700	kBq	27.05.90	0.8	kBq	19.11.14 21.10.14 A
27Co060/16	185	kBq	01.07.75	1.0	kBq	19.11.14 11.11.14 M
27Co060/17	185	kBq	01.07.75	1.0	kBq	19.11.14 11.11.14 M
27Co060/18	185	kBq	01.07.75	1.0	kBq	19.11.14 11.11.14 M
27Co060/19	118	kBq	26.04.68	0.3	kBq	19.11.14 21.10.14 A
842000				22160.2	kBq	
Strontium 90						
38Sr090/05	37000	kBq	27.11.92	21743	kBq	19.11.14 09.10.14 F
38Sr090/06	37000	kBq	19.07.96	23745	kBq	19.11.14 09.10.14 F
38Sr090/07	1850	kBq	01.07.59	485	kBq	19.11.14 24.10.14 N
38Sr090/08	9250	kBq	01.07.59	2423	kBq	19.11.14 21.10.14 A
38Sr090/09	185	kBq	01.07.75	71	kBq	19.11.14 11.11.14 M
38Sr090/10	185	kBq	01.07.75	71	kBq	19.11.14 11.11.14 M
38Sr090/11	185	kBq	01.07.75	71	kBq	19.11.14 11.11.14 M
38Sr090/12	37000	kBq	20.07.11	34133	kBq	19.11.14 13.03.14 G
38Sr090/13	100000	kBq	20.07.11	92250	kBq	19.11.14 13.03.14 G
DESY-Sr90 15	7400	kBq	01.01.14	7244	kBq	19.11.14 22.10.14 G
220000				182236	kBq	
		Aktivität bei Kauf		Aktivität heute		geprüft Ort
Ruthenium 106						
44Ru106/01	4000	kBq	27.09.94	0.00	kBq	19.11.14 21.10.14 A
8000				0.00	kBq	
Cadmium 109						
48Cd109/01	474	kBq	01.09.90	0.001	kBq	19.11.14 21.10.14 A
48Cd109/02	4720	kBq	01.10.92	0.027	kBq	19.11.14 21.10.14 A
8000				0.03	kBq	
Cäsium 137						
55Cs137/01	740	kBq	01.07.90	423	kBq	19.11.14 21.10.14 A
55Cs137/02	371	kBq	20.07.73	144	kBq	19.11.14 21.10.14 A
55Cs137/03	333	kBq	01.07.79	148	kBq	19.11.14 21.10.14 A
55Cs137/04	7400	kBq	15.03.82	3493	kBq	19.11.14 21.10.14 A
55Cs137/09	410	kBq	01.12.82	197	kBq	19.11.14 21.10.14 A
55Cs137/10	453	kBq	01.12.82	217	kBq	19.11.14 24.10.14 N
55Cs137/16	422	kBq	01.04.79	186	kBq	19.11.14 09.10.14 F
55Cs137/18	3700	kBq	01.07.60	1061	kBq	19.11.14 09.10.14 F
55Cs137/19	370	kBq	01.07.60	106	kBq	19.11.14 09.10.14 F
55Cs137/23	55	kBq	01.07.70	20	kBq	19.11.14 21.10.14 A
55Cs137/24	333	kBq	01.07.78	144	kBq	19.11.14 21.10.14 A
55Cs137/25	333	kBq	01.07.83	162	kBq	19.11.14 21.10.14 A
62000				6299.47	kBq	
Barium 133						
56Ba133/02	429	kBq	01.04.79	41	kBq	19.11.14 09.10.14 F
56Ba133/05	200	kBq	01.07.60	6	kBq	19.11.14 22.10.14 A)G
1300				46.33	kBq	
Europium 152						
63Eu152/01	451	kBq	01.04.84	92	kBq	19.11.14 09.10.14 F
100				91.71	kBq	
Wismut 207						
83Bi207/04	392	kBq	01.10.80	193	kBq	19.11.14 09.10.14 F
500				193.04	kBq	
Radium 226						
88Ra226/03	37000	kBq	01.07.60	36138	kBq	19.11.14 21.10.14 A
74000				36138	kBq	
		Aktivität bei Kauf		Aktivität heute		geprüft Ort
Thorium 228						
90Th228/02	3848	kBq	18.01.71	0.000	kBq	19.11.14 21.10.14 A
90Th228/03	1850	kBq	19.05.78	0.00	kBq	19.11.14 21.10.14 A
90Th228/04	1850	kBq	17.01.90	0.2	kBq	19.11.14 09.10.14 F

Labelling requirements



Labelling requirements



Storage rooms for radioactive material:
Additional labelling for fireworkers

Facilities / devices (X-rays or stray radiation)

- Need permission (in most cases)
- Checked by a service company every 5 yrs
- Modifications of facilities:
 - Contact StrISchB
 - StrISchB organizes **inspection** by company
 - StrISchB contacts work safety agency for modification of **permission**

Purchasing / Acquisition and transport of radioactive materials

- **Contact StrISchB**
- Handling of radioactive materials: permission for specific nuclides
- Further regulations exist for:
 - Transport
 - Disposal
- **Always contact the StrISchB !**

Basic principles of radiation protection

ALARA principle:

“As low as reasonably achievable”

“Die 4 A's”

Aufenthaltsdauer	Exposure time	minimize
Abstand	Distance	maximize
Abschirmung	Shielding	optimize
Aktivität	Activity	minimize

Radiation areas

**Einzelpersonen
der Bevölkerung:**

$\leq 1 \text{ mSv/a}$

(Summe aus Direkt-
strahlung und
Ableitungen)

Kontrollbereich

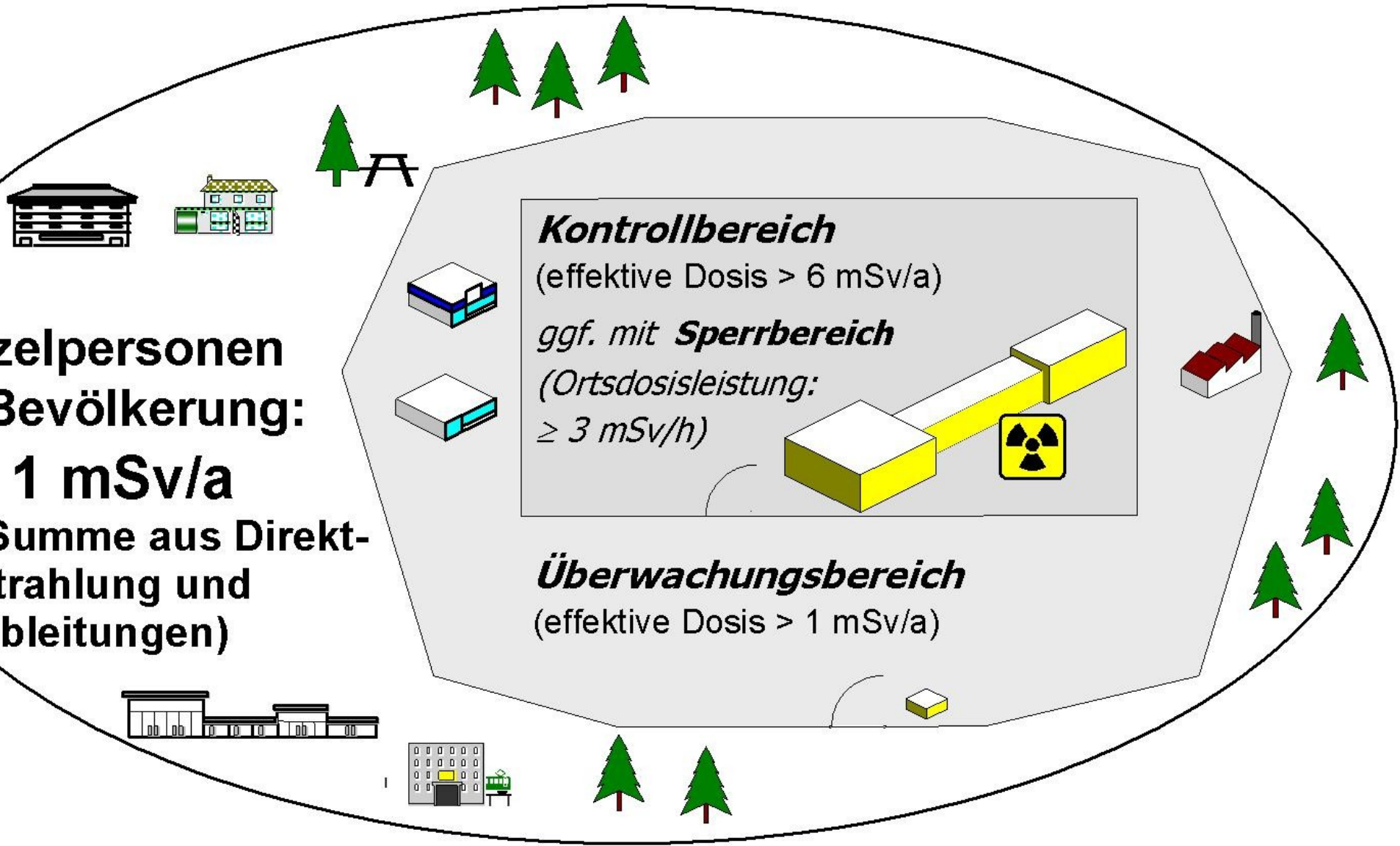
(effektive Dosis $> 6 \text{ mSv/a}$)

ggf. mit **Sperrbereich**

(Ortsdosisleistung:
 $\geq 3 \text{ mSv/h}$)

Überwachungsbereich

(effektive Dosis $> 1 \text{ mSv/a}$)



Limits on exposure to radiation

“Dosisgrenzwerte”

- “Beruflich strahlenexponierte Personen”
persons with radiation exposure **at work**
 - Category A: 6 mSv – 20 mSv per year
regularly inside “Kontrollbereich” / radiation controlled area
 - Category B: < 6 mSv per year
occasionally inside “Kontrollbereich” / radiation controlled area

Only exposures at work are relevant for StrlSchV / RÖV !

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occasionally inside “Kontrollbereich” / radiation controlled area
- **Private radiation exposure:**
 - Medical diagnostics ~ 2 mSv per year
 - Tooth: <0.01 mSv
 - Thorax X-ray: ~0.08 mSv / exposure
 - CT: 2-25 mSv / exposure
 - Natural sources ~ 2 mSv per year
 - Round-trip by plane to New York: ~ 0.1 mSv
 - Cigarettes – Pb210, Po210: 11 cigarettes per day
= 6 mSv organ dose per year

Only exposures at work are relevant for StrlSchV / RöV !

Limits on exposure to radiation

“Dosisgrenzwerte”

- **Special limits:**
 - Persons under 18 years: $< 1\text{mSv / year}$
 - Women: Organ dose at uterus $< 2\text{mSv / year}$
 - Pregnant women: exposition of child $< 1\text{mSv/year}$
- Limits for pregnancy are valid starting with StrlSchB *knowing* about it

Dosimetrie & Strahlenpässe

- **Official dosimetry:**

- for persons who work inside “Kontrollbereich”
- If you work with radioactive material and need a dosimeter, contact me !
- Ordering a dosimeter takes about 4 weeks !



- **Work at “outside-UHH facilities” - Radiation passports (Strahlenpässe):**

- “Arbeit in fremden Anlagen” = work in foreign facilities, **i.e. other than UHH**
- For persons exposed to radiation at work outside UHH (BESSY, Rossendorf, DESY, ...)
- Must follow directives of radiation safety at foreign facility. E.g. safety lecture specific to facility is mandatory
- **Mandatory:** need to be updated before going to the “Fremde Anlage”



Radiation passports

- **Procedure for registration (~2 weeks):**
 - Fill in required information + signatures
 - StrlSchB sends passport to “Amt für Arbeitsschutz” for registration
 - Sent back to me
- **Procedure for passport maintenance**
 - **Passports stay in Office 16**, Building 68
 - **Mandatory regular update** by me
 - If needed for beamtime: **handed out against signature** by me
(Also access to my office: M. Matysek, W. Weppner, D. Horns)
 - Handout along with **OSL-Dosimeter against signature**
 - Note: exceptions exist, where Albedo Dosimeters need to be ordered (~2 weeks !)
 - When back from beamtime, **return passport and dosimeter immediately**
- **Strahlenschutzanweisung zu Genehmigung HH-RA 31/06**

Thanks

Dose and Radiation protection areas

- **Unit: Sievert [Sv] = J/kg**
 - Dose [mSv]
 - Dosisleistung (dose rate) [μ Sv/h]
 - Takes into account energy deposit and biological effective harmfulness of radiation types
- **“Überwachungsbereich” (monitoring area)**
 - 1 – 6 mSv per year
- **“Kontrollbereich” (control area)**
 - 6 – 20 mSv per year
- **“Sperrbereich” (prohibited area)**
 - > 3 mSv/h