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Eidgenössisches Nuklearsicherheitsinspektorat ENSI

Exercising Radiation Protection Planning

as a Relevant Course Content for Training ALARA in NPP

ISOE Symposium

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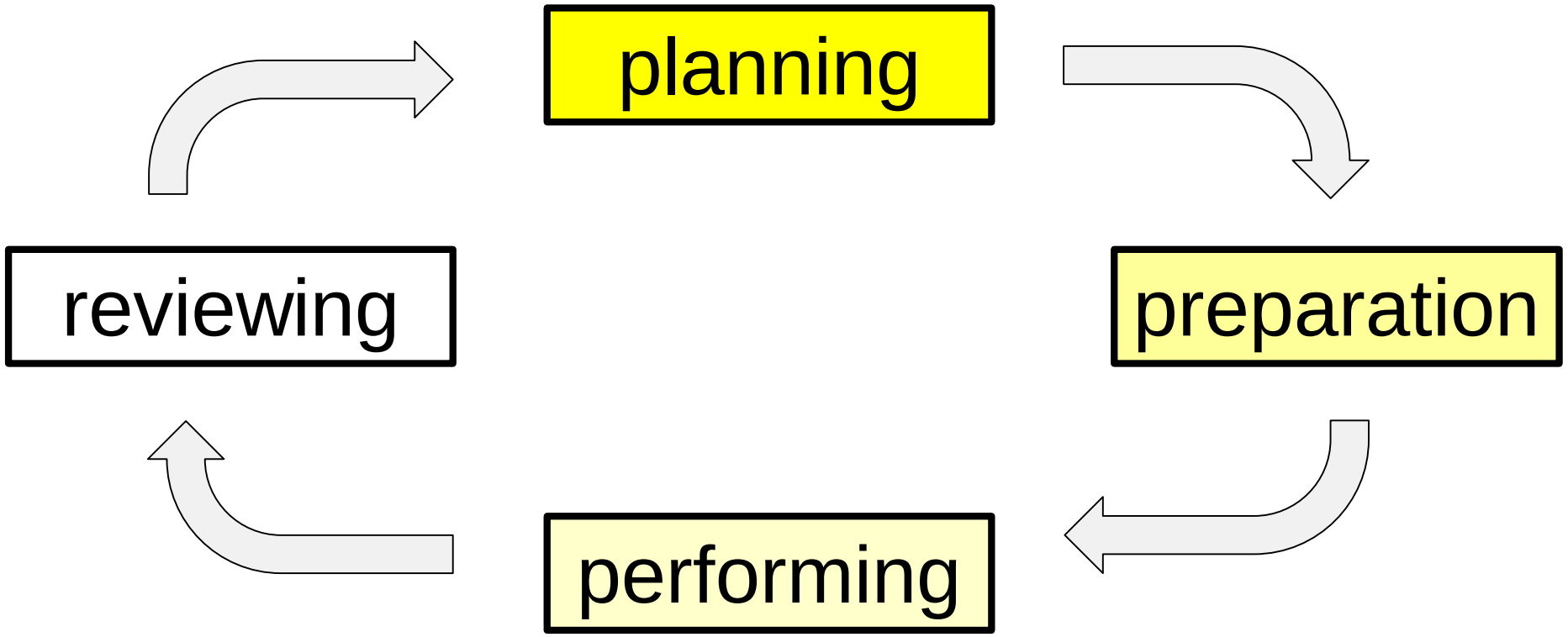
the best moment for consideration

ALARA



situations requiring RP planning

planed exposure situations (situation able to be planned)

- **construction, operation, modification or decommissioning of facilities, installations, laboratories, equipment etc.** *which contains radioactive material or produces ionizing radiation*
- **single */* unique work step, periodical actions, procedure, outage …** *with radioactive material or radiation source or with influence of radiation*

emergency exposure situations

- **emergency preparedness:** *for example prepared organisation, measures and procedures*
- **fast planning** *with tools in SAM decision making process (checklists), whereby ALARA (= optimization) is mostly not possible*

existing exposure situations

Identical to actions in a planed exposure situation

objectives of RP planning

- **checking justification**
- **limitation of dose:**
  regarding feasibility,
  determination of general protection measures and monitoring
- **optimization of RP (ALARA):**
  considering additional measures and variations of work steps …
  to reduce dose
- **precautions to avoid events**
- **preparing measures to minimize the consequences of emergency**
- **saving time, resources and money**

importance of RP Planning

statistic on root causes of 25 events in laboratories for handling radioactive materials in Switzerland
(there may be more the one cause of one event)

cause of event	**Amount**
missing or inadequate planning (design faults, lack of protection measure, unprepared tools and staff …)	10
poor maintenance (aging, …)	8
disregard of rules	5
missing monitoring or incorrect measurement	5
technical failure (specification impossible)	3
external factors (lightning, storm, earthquake, …)	3
insufficient preparation, faulty mounting	3
incorrect regulations / operation instruction	2
missing signs and declarations	2
missing or inadequate instruction, training and education	1

RP Planning in education and training

following examples may be used

- for explaining during teaching
- for exercising

or / and

- for examination (recognition)

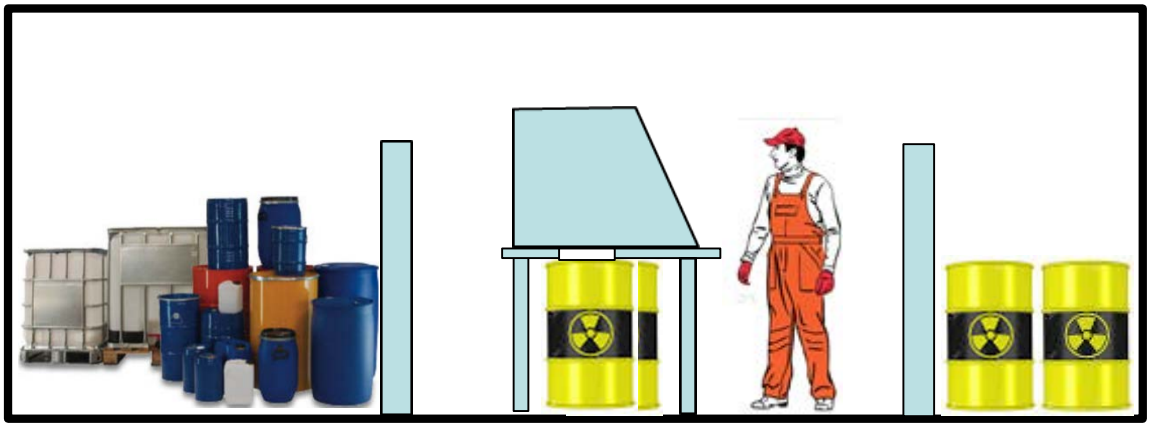
simple example from course for RP Assistants
preparing a waste sorting campaigne

Thinking before starting!

Which situation is better ?

Why?

optimization of distance and shielding



not shielded
max 0.3 mSv/h

shielded drums
0.02 mSv/h

detailed example from course for laboratory staff using open rad. sources and responsible for RP

working in groups on a fictitious procedure:

“production of a planar sealed radioactive source”

- 100 cm^2
- Cs-137
- activity per source = 1 guide value for surface contamination = (300 Bq / 100 cm^2)
- homogenous distribution
- flexible
- surface free of soluble or loose contamination

detailed example from course for laboratory staff using open rad. sources and responsible for RP

working in groups of 2-3 persons: drawing up a

master plan for the production: work steps, necessary human and material resources, equipment, tools etc. …

and in parallel a RP plan: risks, protection measures, monitoring etc. …

each group writes down the results of consideration as key words on cards

the participants should seek for more information by asking the teacher
(very important because it should happen also in reality)

detailed example from course for laboratory staff using open rad. sources and responsible for RP

After 30 min.: one group after the other is **fixing one card on board and explaining the consideration** (takes at least 45 min.)

After all considerations are fixed on board: the teacher should stimulate a discussion about, how the **aspects may be sorted** so that it would become obvious, **what is missing** and, where some **improvements** may be done, the teacher may explain some aspects in detail (takes a lot of time, depending on the knowledge already existing)

As course documentation the **total detailed RP planning report** of this example as well as an example for a **RP Planning checklist** is given to the auditorium

detailed example from course for laboratory staff using open rad. sources and responsible for RP

main aspects of RP plan (part of checklist):

License and its requirements:

Assessment of radiological situation:

Assessment of exposure risk:

Definition of protection targets:

Determination of general and job specific measures:

Dose estimation: max. individual dose, collective dose of staff,

Optimization: considering variations of work steps, measures …

Determination of Monitoring:

Precautions measures:

Waste Management

Responsibilities,

Instructions,

QA, …

complex example from course for
RP technician for nuclear and research facilities

RP technicians have to show their competence and skills by drawing up a

RP plan for a complex project

as a **final examination**

This project should be a **real, future project**

from a research or nuclear facility

so that the RP technician may be involved in
the **preparation, performance and review** of the same project

complex example from course for
RP technician for nuclear and research facilities

Examples of **projects** from a research or nuclear facility:

- New construction of a reactor coolant sampling equipment
- Exchange of dividing-wall in a steam superheating device in a BWR
- Decommissioning of highly alpha-contaminated glove boxes of an hot laboratory
- Sludge lancing and inspection of steam generator tube board
- Construction and operation of a facility for liquid radioactive waste treatment
-
- … around 50 projects in the last 10 years

complex example from course for
RP technician for nuclear and research facilities

These projects are proposed by the RP Manager of the facilities and **approved by the Examination Board** (RP Experts from authority, training facility and license holder)

Each candidate gets **one project with detailed description of tasks with all relevant information and side parameters** at the end of course (after successful written and oral exams)

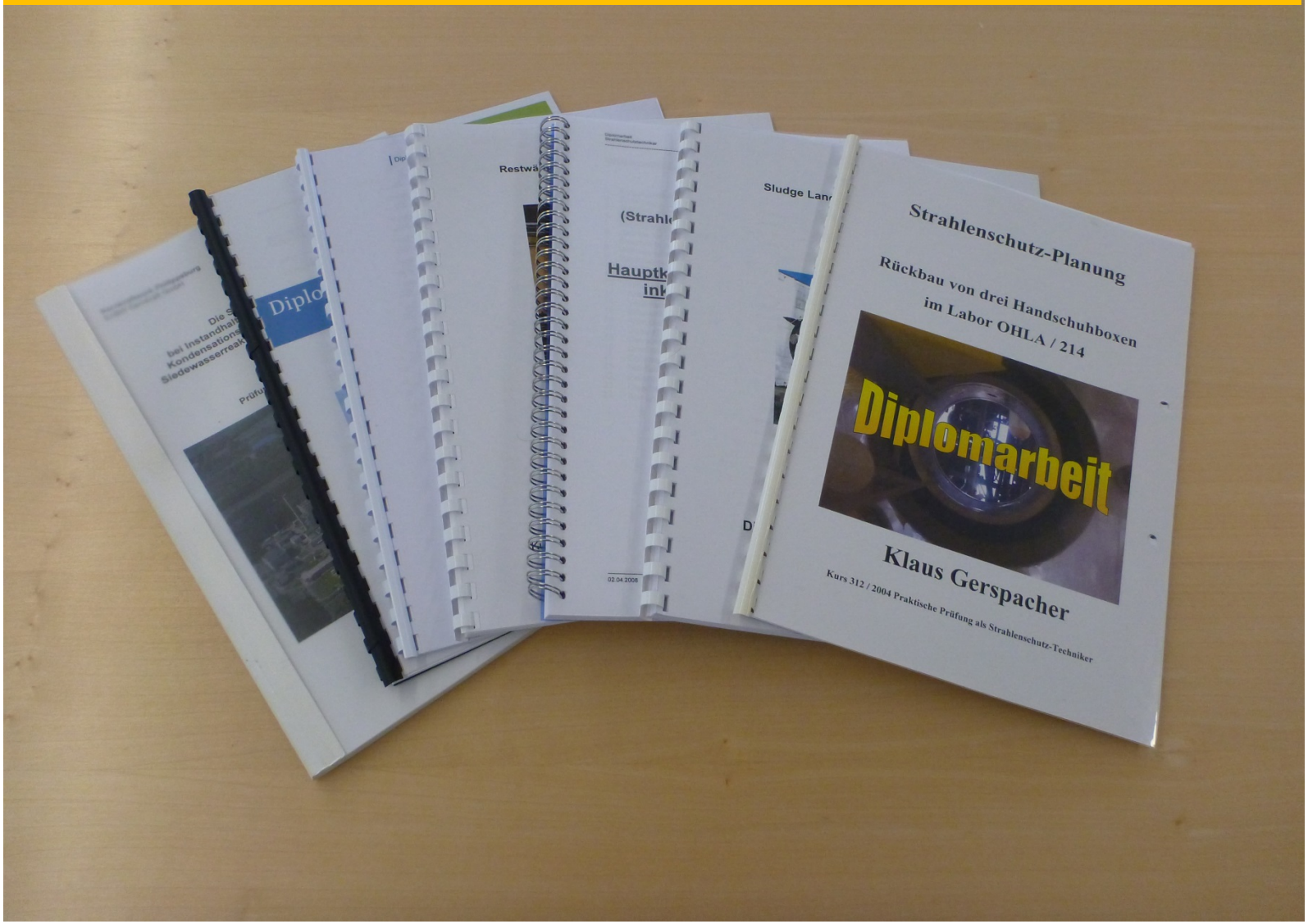
After 10 days an **interim report** has to be presented to the Examination Board

The candidate has to work on questions from Examination Board

5 days later the **final report** has to pass on to the examining board members

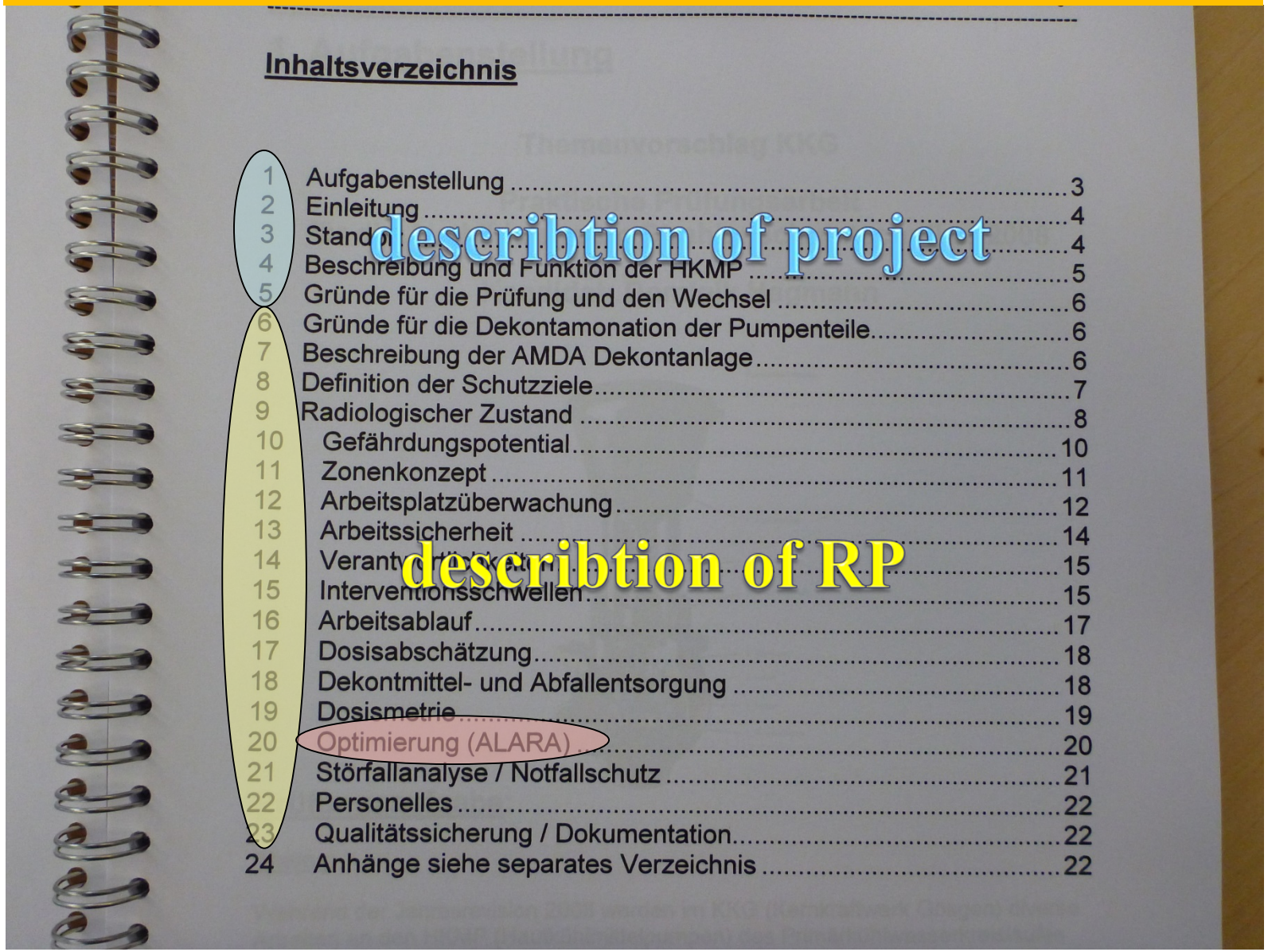
Some days later the **final presentation** to the Examination Board has to be performed

complex example from course for
RP technician for nuclear and research facilities



ENSI

complex example from course for
RP technician for nuclear and research facilities



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describtion of project

describtion of RP

ENSI

Urgent RP planning in a emergency exercise as a mandatory training part for RPE in PWR-NPP

Scenario at t(0): severe earthquake, reactor stopped to zero power, main cooling pumps operating, radioactivity in primary cooling water raises by factor 1000 (due to some broken fuel cladding), severe damage at turbine

Expected Reaction of RPE on duty: Move to emergency response commando room, help to start of ERT, gathering information from main control room about the radiological situation, mobilization of further RP-staff, evacuation of RCA

Scenario at t(10 min): increasing pressure on secondary side of steam generator, SG heating tubes are leaking,

Reaction of RPE on duty: evacuation of persons on site, estimations on potential release, comparing with warning and alert limits, giving order: monitoring of radioactivity in air on-site by wearing personal protective devices, **…**

Scenario at t(20 min): blow off steam valves opens, etc. etc.

Etc.

Resumee

training ALARA =

is mainly training

how to plan RP

for which you need core competences and a lot of examples from the practice

Thank you!

Questions?

Cat. 1.: Exposed Persons

group of persons depending on their role, tasks and responsibility *examples*	information resp. education & training *content, objectives*
Exposed Persons, not directly handling with sources or radiation:	**responsibility lies by the licensee**
• **not occupationally exposed, E < 1mSv/y for normal operation** *gardener, secretary, …*	**information and instructions** *basic rules and bans in RP, reaction on alarm*
• **occupational exposed, E > 1mSv/y may be** *painter, electrician, member of emergency org. like policeman, first aid services …*	**instructions/briefing** *health effects from irradiation, rules and bans, reaction on alarm, natural exposure and estimated exposure from job*

Cat. 2.: Persons handling with sources

group of persons depending on their role, tasks and responsibility *examples*	kind of information resp. education & training *content, objectives*
persons, handling with sources or radiation *operator, maintenance staff, radiographer assistant, laboratory worker, …*	**basic education and training** • the licensee is responsible for the coordination, • no recognition necessary *+…basic knowledge on physics of radiation and interaction with matter, basic rules of radiation protection, optimized handling, application of legal requirements and company rules*

Cat. 3.: Persons responsible for RP for other persons (RP-person in charge)

group of persons depending on their role, tasks and responsibility *examples*	kind of information resp. education & training *content, objectives*
persons, assuming responsibility either • **on particular RP duties in a enterprise or** • **on actions in an emergency response or** • **on medical applications on patient or** • **on giving advice in case of radon occurrence** *RP-controller, RP-technician, shift leader in NPP control room, …* *firemen instructor, …* *staff nurse for x-ray diagnosis, surgeon, …* *cantonal radon expert (new),*	**education and training,** • controlled or coordinated by the licensee, • some are part of vocational E&T • **recognized by the competent authority** *Education content and objectives depend strongly on kind of handling, risk of application* *The ordinance about education and training include requirements on* ***19 different RP-person-groups*** *Duration of E&T varies from* • *1 day for driver of radioactive goods (ADR)* • *½ year RP school, ¼ year on the job training and 3 years experience for RP-technician in NPP*

Cat. 4.: “RP-Commissioner”

group of persons depending on their role, tasks and responsibility *examples*	kind of information resp. education & training *content, objectives*
RP-commissioner appointed by licensee responsible to ensure RP in and outside of the premises in conformity with legal rules *RP-commissioner working as a radiographer responsible for instruction of other staff, …* *RP-Manager of nuclear power plant, …* *Medical Physics Expert in a hospital, …*	**education and training,** • recognized by the competent authority (recognition of training courses or individual competences) *Education content and objectives depend strongly on kind of handling and risk of application* *The ordinance about education and training include requirements on **21 different RP-commissioner***

Strahlenschutzplanung: Dosisabschätzung

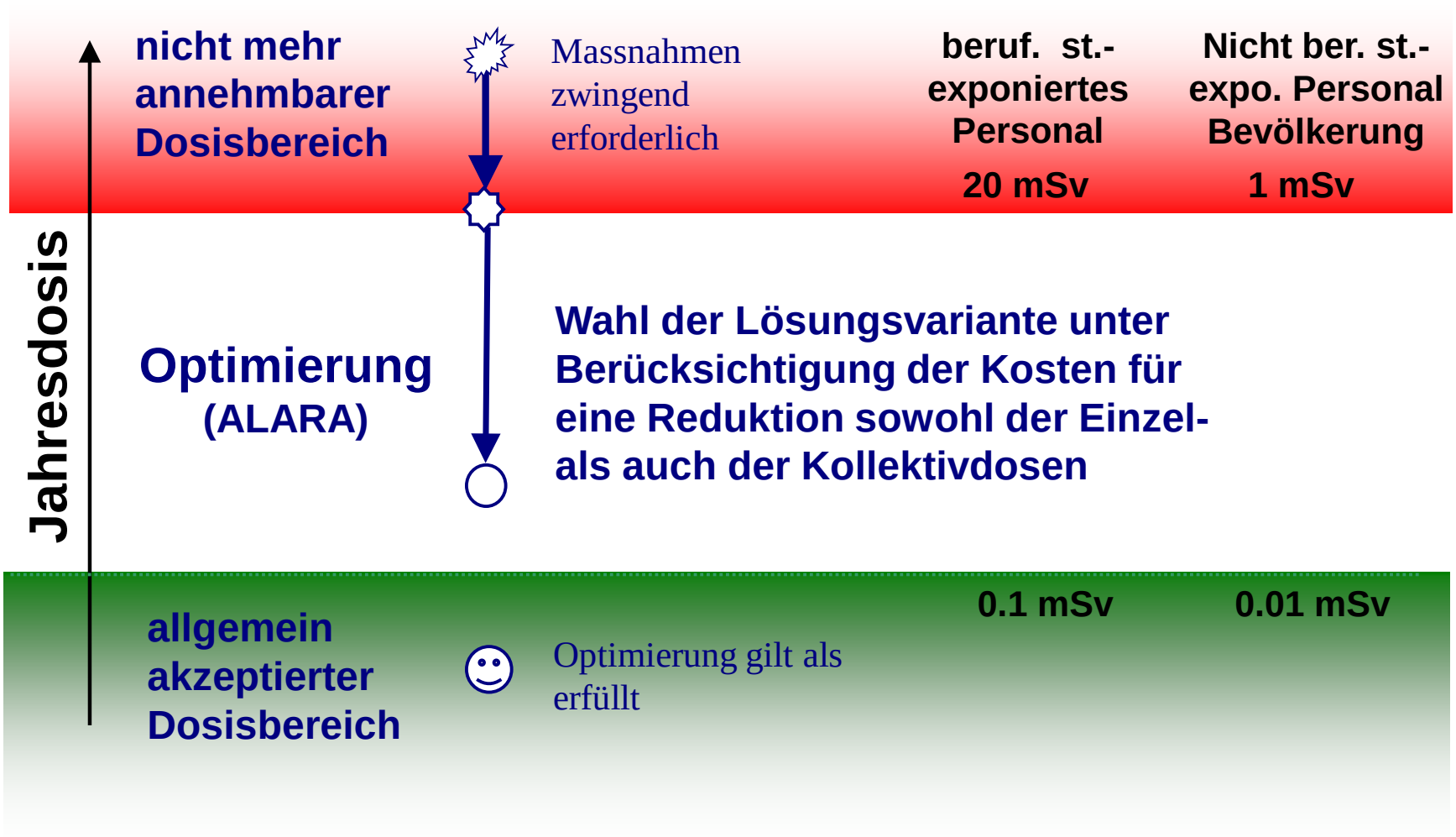
Beispiel einer Abschätzung von Kollektivdosen durch externe Bestrahlung

Aktion	Person	Wie oft	Aufenthalts-zeit im Raum [h]	Durchschn. Dosisleistung [mSv/h]	Aufenthalts-zeit an Quelle [h]	Inhomo. DL in 1 Meter [mSv/h]	Abstand [m]	Dosis [mSv]
Vorbereitungsarbeiten (Gerüstbau, Isolation entfernen, Abschirmung fixieren)	A	1	1	0.2	0.1	3	1	0.5
	B	1	1	0.2	-	3	-	0.2
	C	1	1	0.2	-	3	-	0.2
Prüfmessung Hinten	D	3	0.33	0.2	0.1	3	0.5	1.4
Prüfmessung Vorn	D	3	0.33	0.2	0.1	3	0.5	1.4
Aufräumarbeiten (Abschirm. Entfernen, Isoation anbringen, Gerüst abbauen)	A	1	1	0.2	0.1	3	1	0.5
	B	1	0.5	0.2	-	3	-	0.2
Summe in Pers.mSv								4.4

Häufig benutzte Programme zur Berechnung von Gamma-Dosisleistungen (und Dosis) durch radioaktiver Quellen (Stand 2003)

Name	Kosten	Vorteile	Nachteile
Microshield (Framatom)	ca. 2000 CHF	einfach zu bedienen, weit verbreitet	nur eine Quelle, nur Photonen, Ausgabe nicht exportierbar
Mercurad (Canberra)	ca. 8000 CHF	noch wenig verbreitet, mehrere Quellen	nur Photonen, Eingabe und Ausgabe mangelhaft
Visiplan (sckcen.be)	ca. 12000 CHF	mehrere Quellen, Dosis anhand Arbeitsablauf	in der Praxis selten nützlich
MCNPX	umsonst	Photonen, Elektronen, Neutronen, …	Komplexe Eingabe, bedingt viel Erfahrung

Strahlenschutzplanung: Optimierung



ALARA: As Low As Reasonable Achievable
⇨Berücksichtigung Aufwand – Dosisersparnis

Alpha-Wert: Gerechtfertigte Kosten zur Reduktion der Dosis von beruflich strahlenexponierten Personen für Schutzmassnahmen

Kosten / eingesparte Dosis > **Alpha-Wert**

- in der Schweiz (KKG / PSI, KKB): 300 bis 3000 CHF pro mSv
- in Deutschland (VGB): von 0,1-10 mSv: 50 bis 500 Euro/mSv
  von 10-20 mSv: mit der Dosis auf 5000 Euro/mSv steigend
- in USA (gemäss ISOE): 500 bis 4000 $/mSv (Tendenz zeitlich steigend),

typischer Mittelwert = 1400 $/mSv

RP planning: a relevant aspect is monitoring

"It went around twice and stopped on 18."

Viel Erfolg bei der nächsten Strahlenschutzplanung