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Eidgenössisches Nuklearsicherheitsinspektorat ENSI

Exercising Radiation Protection Planning

as a Relevant Course Content for Training ALARA

EAN-Workshop

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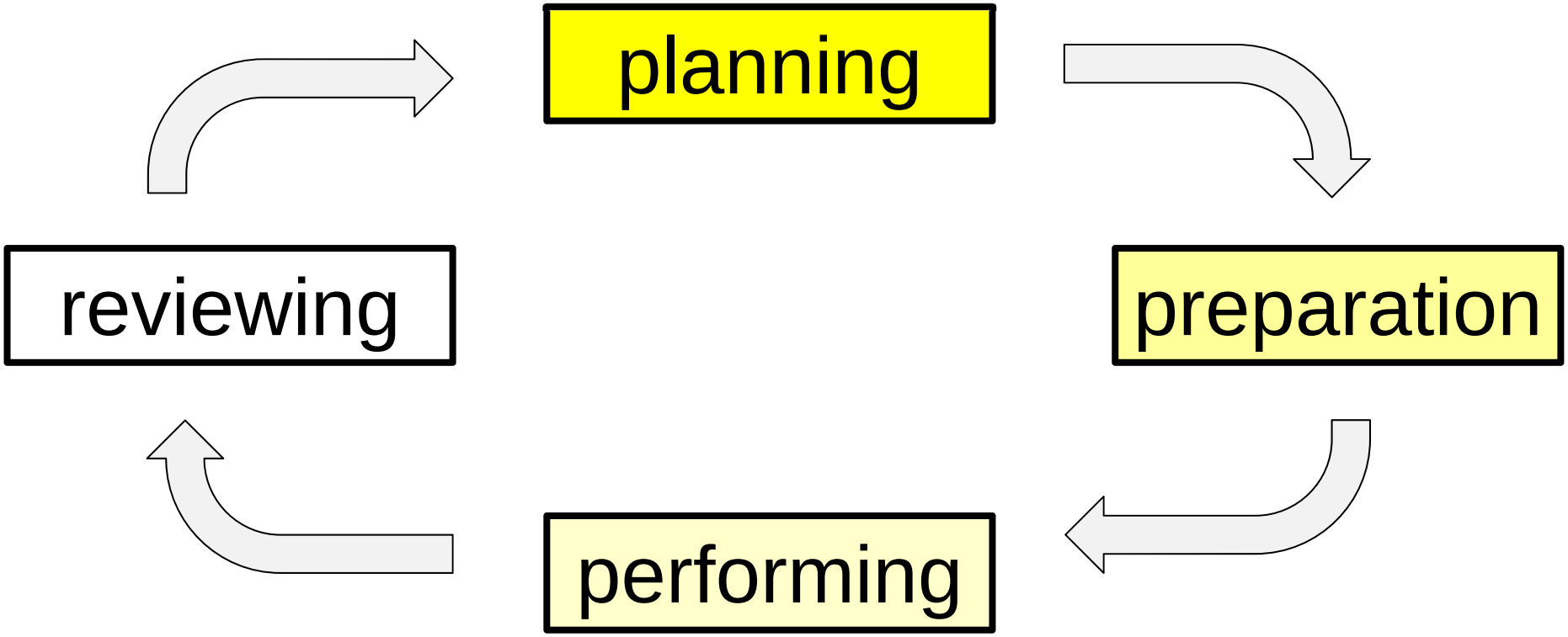
Swen-Gunnar Jahn

Content

- situations for, targets and importance of RP planning
- examples from education and training:
  - simple example as an exercise for drivers radioactive goods
  - detailed example from training of laboratory personal with RPO tasks
  - complex example from examinations of RP technician
- resumee

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

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targets of RP planning

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

"I'll have to X-ray your arm again. This one is overexposed."

importance of RP Planning

statistic on 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 fault	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 procedure

RP planning should be

- **integrated** into the master plan or at least
- **parallel** to drawing up the master plan

whereby the RP planning should be drawn up **iteratively with the master plan** because it may effect the art and sequence of work steps as well as the used materials, tools, equipments

RP planning should not start after finishing the master plan

possible forms of RP planning

depending on risk of exposure and complexity of a situation as

- individual dose of staff
- collective dose of staff
- risk of incorporation dose of staff
- high dose rate
- using high toxic,easy spread, hardly measureable nuclides
- possibility of radioactivity release to the environment
- possibility of exposure to the public

following forms of RP planning may be chosen

- *planning RP by heart (thinking without any documentation)*
- *verbal orientation, notices in a leaflet*
- ***laboratory log book, drawing up instruction leaflet***
- ***check lists, technical reports, job specification form ...***
- ***RP Planning reports, safety considerations form***
- ***Safety Analysis Reports***

RP Planning in education and training

following examples may be used

- for explaining during teaching
- for exercising

or / and

- for examination (recognition)

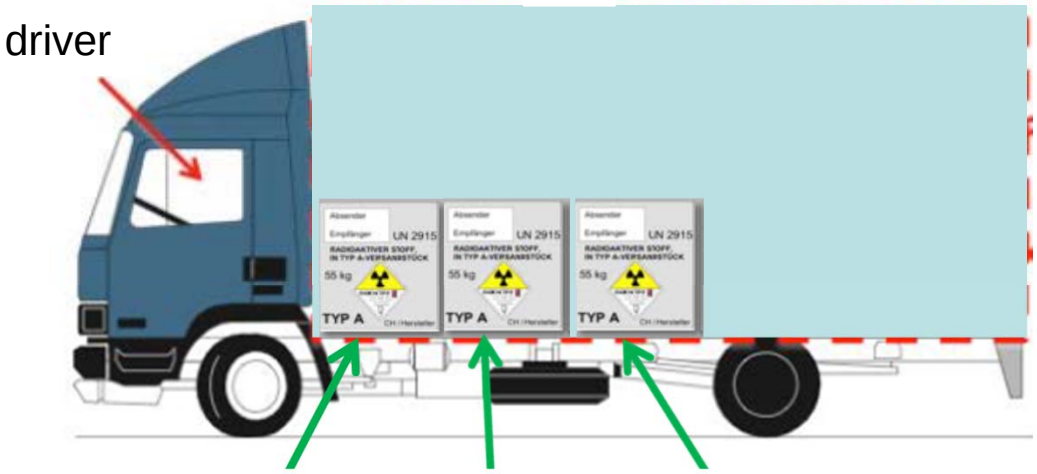
simple example from course for
drivers of radioactive goods (class 7 ADR)

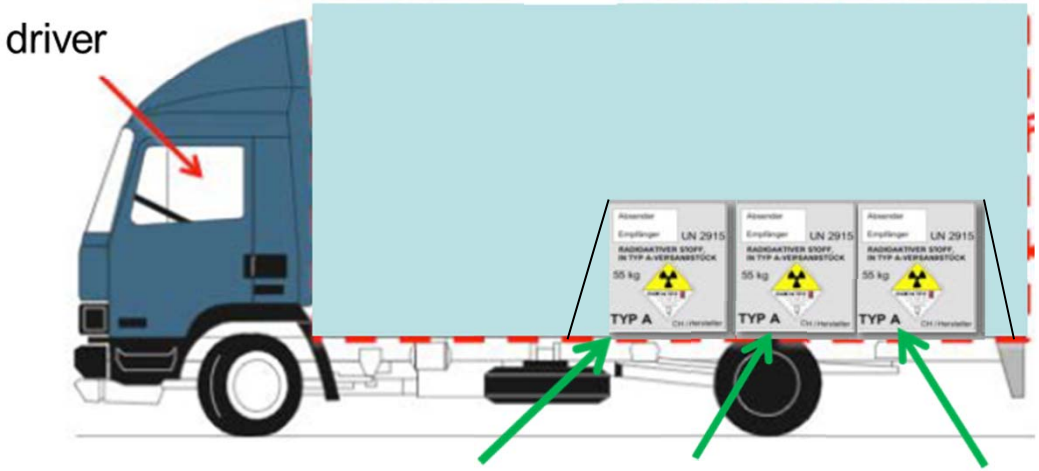
Thinking before loading!

duration of transportation is longer than loading

What is better for the driver?

Why?





TI = 0,1 TI = 1 TI = 10

detailed example from course for
RP professionals for labs using open rad. sources

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
RP professionals for labs using open rad. sources

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
RP professionals for labs using open rad. sources

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
RP professionals for labs using open rad. sources

main aspects of RP plan:

License and its requirements: allowance for handling nuclide, staff classification, …

Radiological situation: sources, contamination, radioactivity distribution in facility and environment, dose rate, …

Exposure risk: exposure pathway to staff, population, …

Protection targets: Dose limits, dose contingents, dose constraint, activity limits, contamination limits etc.

General measures: Source term reduction, radiation control area, shielding, personal protection, …

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

Optimization: considering variations of work steps, measures …

Monitoring, precautions, 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

(in some cases it could be also an just ongoing or completed project)

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 examining 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)

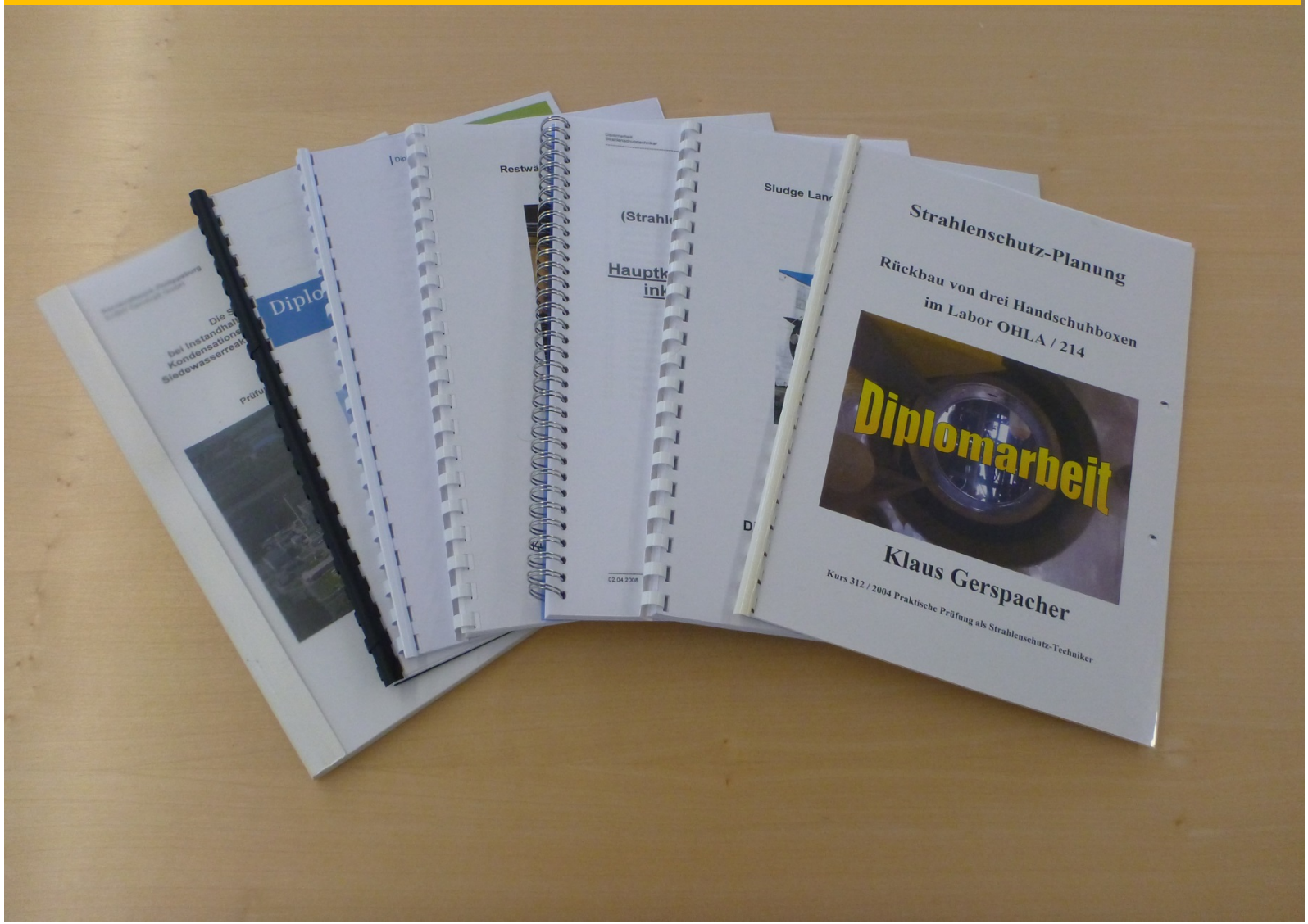
After 10 days an **interim report** has to be presented to the examining board

The candidate has to work on questions from examining board

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

Some days later the **final presentation** to the examining board has to be performed

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



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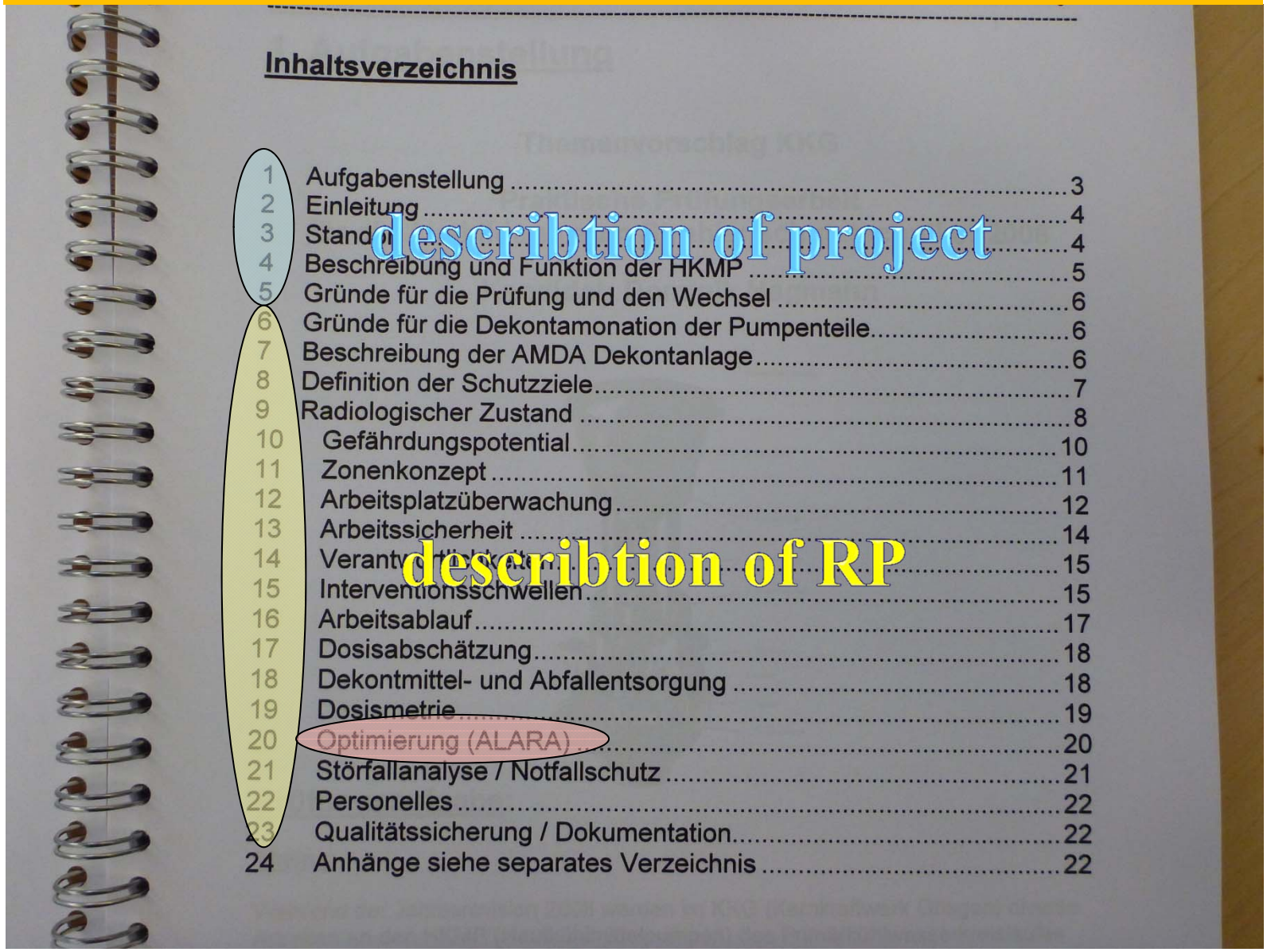
complex example from course for
RP technician for nuclear and research facilities



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describtion of project

describtion of RP

ENSI

Resumee

training ALARA =

is a part of training

how to plan RP

for a new facility or action

Thank you!

Strahlenschutzplanung: Dosisabschätzung

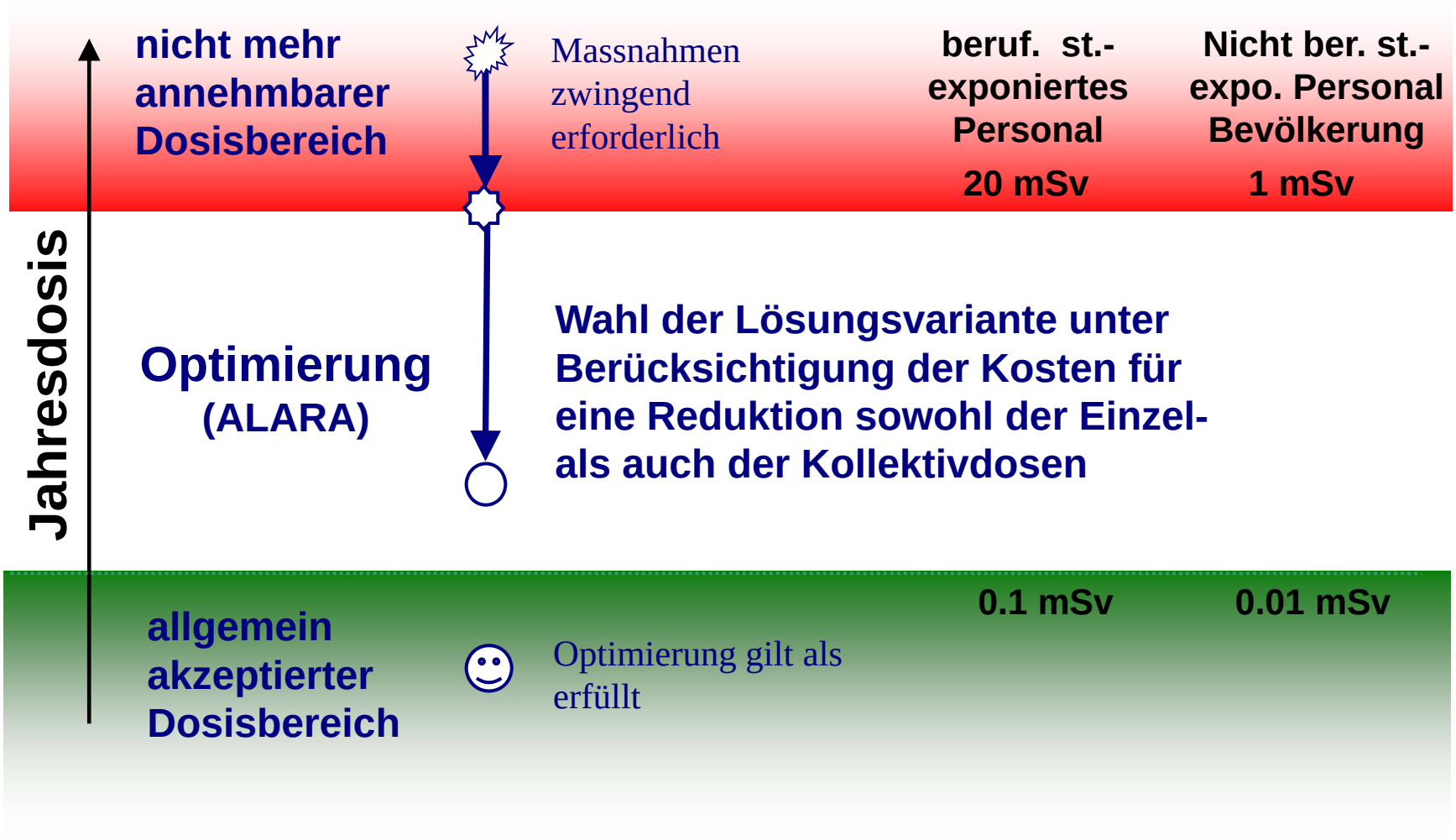
Beispiel einer Abschätzung von Kollektivdosen durch externe Bestrahlung

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