EU-project TENORMHARM

Contract-No. FIGM-CT-2001-00174

"New approach to assessment and reduction of health risk and environmental impact originating from TENORM according to requirements of EU directive 96/29"

Deliverable No. 9

3.2. National report to legislative aspects: GERMANY

[Nature: Re; Dissemination level: PU]

Participant No. 7:
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31 March 2004

UNIVERSITÄT
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Prepared by

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31 March 2004

1. Introduction

Since the EU-directive 96/29/EURATOM is implemented in German law as being part of the Radiation Protection Ordinance (StrSchV 2001), no further guideline for improving is necessary.

The German radiation protection ordinance is released on 20th July 2001 being part of the Federal Statute No. 38. This ordinance was established to meet the requirements of the EU-directive 96/29/EURATOM, which was adopted on 13th May 1996 and concerns the basic safety standards for health protection of workers and members of the public against hazards resulting from ionising radiation in general. Furthermore, the EU-directive 97/43/EURATOM being adopted on 30th June 1997 is also taken into account concerning the health protection of persons against hazards resulting from ionising radiation occurring as medical exposition.
The German radiation protection ordinance is separated into five parts:
Part 1: General instructions
Part 2: Protection of person and environment against radioactive materials or ionising radiation occurring in the frame of special activities
Part 3: Protection of person and environment against natural radiation of occupation
Part 4: Protection of the consumer on addition of radioactive substances in products
Part 5: Common instructions
Fourteen annexes are added for further explanations.

In frame of the TENORMHARM-project, title VII ***"Significant enhanced exposure by natural radiation"*** of the EU-directive 96/29/EURATOM is in the main focus. Therefore, part 3 and its annexes XI and XII are those ones of main importance and are presented in the following.

This is a scientific report without any demand for juridical correctness. Spaces in brackets *[...]* are just used in cases of heavy bureaucratic explanations without any disadvantage for understanding the context.

2. Legislative competence

The legislative competence concerning natural radiation is conferred on the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) lead by Mr. Jürgen Trittin. Three Federal Authorities are directly subordinated designed for special tasks:

1. Federal Environment Office (UBA):
   - identifying, describing and reviewing the state of the environment in order to recognise detractions of man and nature as soon as possible
   - preparing professional concepts and proposing actions for efficient nature conservation

2. Federal Nature Conservation Agency (BfN):
   - giving advice to the BMU concerning national and international nature protection and environment conservation
   - encouraging and supervising nature conservation projects
   - authority for licensing im- and exportation of animals and plants

3. Federal Radiation Protection Agency (BfS):
   - safety and protection of man and nature against ionising (medical radiation, handling of radioactive materials, enhanced natural radiation) and non-ionising radiation (mobile phones, UV-radiation)
   - continuous environmental radioactivity measurements for radiation protection
   - radiological protection in emergency cases
   - conservation and disposal of nuclear fuel and radioactive waste material

The NORM/TENORM-problem is assigned to the Federal Radiation Protection Agency (BfS), whose organisational structure is shown in fig. 1 (next page; the path for NORM/TENORM is given red).

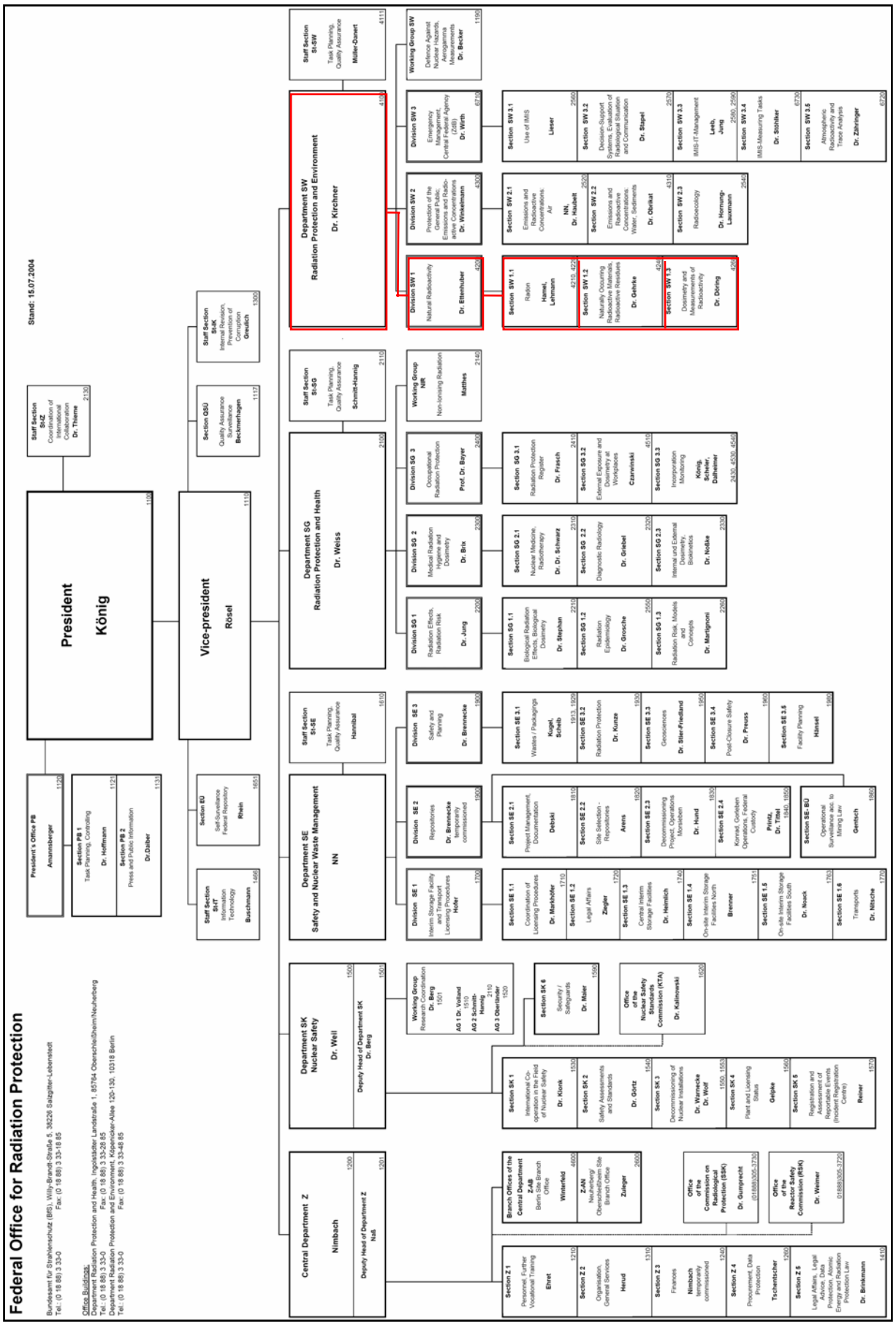

Fig. 1: Organigram of the Federal Office for Radiation Protection (BfS) [path for NORM/TENORM given in red].

3. Part 3 - Protection of person and environment against natural radiation

P. 1751-1755; §§ 93-104

Chapter 1, Basic Duties

§ 93
Dose limitation
Everybody doing a job on his own or instructing someone else to do a job mentioned in chapter 2 and 4 is responsible for observance of dose limits.

§ 94
Dose reduction
Everybody doing a job on his own or instructing someone else to do a job mentioned in chapter 2 and 4 is responsible for opportunities to keep the radiation exposure as low as possible.

Chapter 2, Requirements for terrestrial Radiation at Places of Employment

§ 95
Natural occurring radioactive substances at places of employment
(1) Everybody doing a job on his own or instructing someone else to do a job mentioned in annex XI is forced to do an estimation of the Rn-222 exposure or of the personal dose within 6 months. This must be repeated immediately if the place of employment is changed for a possible increased radiation exposure.
(2) If the effective dose measured in the frame of estimation mentioned in (1) exceeds the limit of 6mSv/a, an announcement must be undertaken within 3 months and sent to the respective authority. The announcement must consist of a concrete description of the work, the surround concerned and the number of persons concerned receiving an effective dose more than 6mSv/a. Rn-222-exposures are to be taken as not exceeding this limit if the product consisting of Rn-222 activity concentration at the place of employment and duration of stay does not exceed the level of $2 * 10^6$Bq/cbm*hrs. In case of a significant deviation from the equilibrium factor for Rn-222 and its short live decay-products, which is given by 0.4, authority is authorised to fix deviating levels for the Rn-222 activity concentration and the duration of stay.
(3) Those ones mentioned in (1) are forced to carry a complete Radiation Card registered at the respective authority, if the work is to be announced.
(4) The effective dose limit for persons doing a job to be announced is fixed at 20mSv/a. The limit for the organic dose amounts for the eye 150mSv, for skin, hands, forearms, feet and ankles respectively 500mSv. Rn-222-exposures are to be taken as not exceeding the effective dose limit if the product consisting of Rn-222 activity concentration at the place of employment and duration of stay does not exceed the level of $6 * 10^6$Bq/cbm*hrs.
(5) The limit of the total effective dose for persons being officially exposed determined in all years of employment is fixed at 400mSv. An additional exposure of an effective dose of maximal 10mSv/a can be licensed if an agreement with a doctor is met and the person concerned agrees.

(6) If an exceeding of one limit mentioned in (4) is determined, a further employment just can be licensed if the exposure in the following four years is not exceeding the five times higher limit of total amount of effective doses. *[...]*
(7) The effective dose limit for person under the age of 18 is fixed at 6mSv/a. The limit for the organic dose amounts for the eye 50mSv, for skin, hands, forearms, feet and ankles respectively 150mSv.
(8) The total dose amount limit of external and internal radiation exposure for an unborn child, which is exposed to radiation due to the employment of the mother, is fixed at 1mSv/a. This is valid for the duration from the point of announcing the pregnancy until its end.
(9) If a woman informs her employer about a pregnancy, he is forced to set the working conditions for an exclusion of internal exposure.
(10) Everybody doing a job on his own or instructing someone else to do a job mentioned in (1) is forced to determine the Rn-222 exposure and the organic dose in a meaningful way by measuring the dose, the dose rate, the concentration of radioactive substances or gases in air, the contamination of the place of employment, the personal dose, the organic activity or the activity of the excrements. The Rn-222 exposure can also be determined directly. The measuring results must be delivered to the person concerned at least within nine months. The kind of measurements to be applied can be fixed by the respective authority.
(11) Everybody doing a job on his own or instructing someone else to do a job mentioned in (1) can just continue his work or let continuing the work of persons concerned if an examination by a doctor including a certification of no health objection is undertaken within one year. *[...]*
(12) If a work situation leads to a lower effective dose than 6mSsv/a, the requirements of § 94 can also be met by applying radiation protection measures based on instructions of the common working protection. The respective authority can demand for special proofs.

§ 96
Documentation and further steps of protection
(1) Everybody doing a job on his own or instructing someone else to do a job mentioned in § 95 (2) is forced to record immediately the results of the measurements. The Rn-222 exposure must be given as an effective dose.
(2) Those ones obligated according to (1) must
1. deal with the records as follows:
   a) preserve until the person controlled fulfilled or would have fulfilled the age of 75, at least 30 years after finishing the work;
   b) delete not later than 95 years after birth of the person concerned;
   c) present in case of demanding by the person concerned or the respective authority;
   d) present in case of demanding by the new employer in case of changing the place of employment, if a further employment as an exposed employee is undertaken;
2. notify an exceeding of limits mentioned in § 95 (4), (5), (7) and (8) to the respective authority by declaration of reasons, the persons concerned and the organic doses determined;
3. in case of 2. inform the person concerned about the organic dose.

(3) Those ones obligated according to (1) or § 95 (10) must transmit the determined organic dose *[...]* to the respective authority for a further notification to the Radiation Protection Registry within one month after recording. The Radiation Protection Agency decides the form and proceeding of transmitting. *[...]*
(4) As far as the conditions of exposure demand, the respective authority arranges useful measures corresponding to §§ 30, 34-39, 43-45, 47 (3), § 48 (2), § 67 and § 68 (1). It also arranges the kind of utilisation of the resulting materials.
(5) *[...]*

Chapter 3, Protection of members of the public against natural occurring radioactive substances

§ 97
Residuals to be observed
(1) Everybody doing a job on his own or instructing someone else to do a job resulting in residuals to be observed, which can lead to enhanced exposure of more than 1mSv/a for single members of the public, is forced to take further steps for protection of people.
(2) Residuals are to be observed if mentioned in annex XII part A. In case of an assured removal or utilisation according to the limits given in annex XII part B complying with the way of removal or utilisation fixed by authority, an observation can be omitted. It is not allowed to mix or dilute residuals to be observed with other materials in order to meet the requirements of annex XII part B.
(3) The respective authority can demand for a proof of residuals to be observed complying with the limits mentioned in annex XII part B. Therefore, authority is able to decide the way of technical processes, meaningful measurements and further steps, especially measuring the specific activity concentration.
(4) Those ones obligated according to (1) are forced to protect the residuals to be observed against spiriting and gripping by not authorised persons. It is just allowed to pass on the residuals to be observed to other persons for removing and utilisation.

§ 98
Discharge of residuals from controlling
(1) The respective authority discharges residuals to be observed from controlling if an intended removal or utilisation is assured and members of the public are not exposed to radiation. The limit of exposing members of the public by removal or utilisation is fixed at 1mSv/a without any further measures. *[...]*
(2) Proofing according to (1) is to be done by applying basics of annex XII part D. Employees for removing or utilisation are taken as single members of the public. If the residuals are to be deposited together with other residuals or waste materials, the respective authority is allowed to take the assumptions of annex XII part C for assured.
(3) A discharge can just be undertaken if no hesitation against waste juridical admissibility of how to remove or to recycle exists. An explanation concerning the deposition of the waste material and an adopting explanation of the removing or utilisation person must be present for the respective authority before certification according to (1). *[...]*

§ 99
Residuals remaining in further controlling
Those ones obligated according to § 97 (1) are forced to announce the respective authority within one month about the type, mass and specific activity concentration of the residual to be observed as well as the planned removal or utilisation if a discharge from controlling according to § 98 (1) is impossible. The respective authority is allowed to arrange measures of protection and how to remove the residuals.

§ 100
Duty for announcement, residual concept, residual statement
(1) Everybody doing a job or instructing someone else to do a job in his own factory resulting in more than 2,000t per year of residuals mentioned in Annex XII part A or using those ones must announce it the respective authority at the beginning of each year.

(2) Those ones obligated according to (1) are forced to create a concept concerning the removal and utilisation *[...]*, which is to be handled as an internal scheduling instrument. It must contain:
1. Announcement of the type, mass, specific activity and remaining of the residuals including estimations about the residuals occurring the next 5 years.
2. Presentation of the removal and utilisation steps met and scheduled to meet in the next 5 years.

(3) The removal and utilisation concept for the next 5 years must be created firstly for the 1. April 2003. It must be continued each 5 years and can be demanded earlier by respective authority. Form and content can be demanded for meeting respective requirements.
(4) Those ones obligated according to (1) are forced to create annually, the first time on 1. April 2004, a balance-sheet for the year before containing announcements about type, mass, specific activity and remaining of the removed and recycled residuals and present it in case of demanding by respective authority. *[...]*

§ 101
Remove of radioactive pollution on premises
(1) Everybody finishing a job according to §97 (1) is forced to remove pollution caused by residuals to be observed before the premise is used by someone else, but within 5 years latest after finishing the job. Eventual residuals are not allowed to cause further limitations of using. Standard for using the premise without any limitation is an effective dose of lower than 1mSv/a for the radiation exposure of single persons being member of the public caused by not removed residuals.
(2) Those ones obligated according to (1) are forced to announce the finished pollution removal the respective authority within 3 months. *[...]*. Authority can demand for proofing the remaining of the removed residuals.
(3) The respective authority can release from the duty according to (1) in total or partially in single cases, if steps of protection are undertaken preventing an effective dose of more than 1mSv/a for the radiation exposure of single persons being member of the public without removing the residuals. *[...]*

§ 102
Controlling other materials
Respective authorities can make dispositions if jobs dealing with materials not mentioned in annex XII part A or the doing of jobs resulting in such materials, which are enhancing considerably the radiation exposure of single persons being member of the public, that steps of protection must be undertaken. Especially the following dispositions can be made:
1. Respective steps of protection must be undertaken
2. Materials must be stored at a site defined by authority
3. Materials must be removed

Chapter 4, Cosmic Radiation

§ 103
Protection of aircrews against expositions by cosmic radiation
(1) Everybody operating industrially, or as a member of a company, in aircraft business as defined in the German air traffic statute *[...]* is forced to determine the effective dose for those aircrews being engaged according to the German industrial law, if the cosmic radiation may exceed the limit of 1mSv/a. The results of determination must be presented six months after

employment as the latest. This is also valid for military aircrews being engaged by the German Ministry of Defence.
(2) The effective dose limit for cosmic radiation is fixed at 20mSv/a for aircrews. The requirements of reducing the dose according to § 94 can be met especially by creating the employment schedules for the aircrews and by fixing the air-routes.
(3) The limit for the total of all annually determined effective doses is fixed at 400mSv/a for all persons being occupationally exposed. A further exposure being lower than 10mSv/a effective dose can be allowed by authority, if the person concerned agrees and a doctor did an examination. The agreement must be done in writing.
(4) If an exceeding of one limit mentioned in (2) is determined, a further employment just can be licensed, if the exposure in the following four years is not exceeding the five times higher limit of total amount of effective doses. *[...]*
(5) The total dose amount limit of external and internal radiation exposure for an unborn child, which is exposed to radiation due to the employment of the mother, is fixed at 1mSv/a. This is valid for the duration from the point of announcing the pregnancy until its end.
(6) Those ones obligated according to (1) are forced to inform the aircrews once a year about the health effects resulting from cosmic radiation and the intention of controlling the dose limits and radiation protection basics. Especially women are to be informed to declare their pregnancy as fast as possible due to the risks for the unborn child resulting from radiation exposure. *[...]*.Those ones obligated according to (1) are forced to register the content and date of informing. This register must be stored for 5 years after informing and can be demanded by respective authority.
(7) Those ones obligated according to (1) are forced to
1. register the results of dose determination according to (1) immediately
2. the register according to 1.
   a) must be stored as long as the person controlled is or would be younger than 75, at least 30 years after finishing employment
   b) must be deleted 95 years after birth of the person concerned at latest
   c) can be demanded by the person controlled or respective authority *[...]*
   d) must be delivered to the new employer if a change of employment including radiation exposure takes place
3. inform immediately the respective authority in case of exceeding the effective dose limit by giving the reason, the person concerned and the doses determined
4. inform the person concerned in case of 3. about the effective dose

(8) Those ones obligated according to (1) are forced to inform the Federal Aviation Agency about the effective dose for forwarding to the Radiation Protection Register. *[...]*
(9) Those ones obligated according to (1) can only allow persons having received a higher effective dose than 6mSv/a to continue their work, if those are examined by a doctor within one year and a certification exists declaring a work continuation is without any doubt for health. *[...]*

Chapter 5, Work Organisation

§ 104
Duties to inform about work organisations
(1) The respective authority must be informed who is the one obligated according to this ordinance. If the juridical person consists of several members being part of one company, the obligated person must also be announced. *[...]*

Annex XI

(concerning §§ 93, 95, 96)

Activities where considerable enhanced Expositions resulting form natural terrestrial Radiation Sources can occur

Part A: Activities of enhanced Radon-222-expositions
Working in

1. underground mining, pits and caves including pits for visitors
2. Radon-spas
3. installations for water exploitation, -treatment and -distribution

Part B: Activities of enhanced expositions by uranium, thorium and their decay products without Radon

1. Grinding of and welding with thoriated welding electrodes
2. Treatment and storage of thoriated welding electrodes
3. Application of natural thorium (Th-232) and natural uranium (U-238 and U-235) for chemical-analysing and chemical-preparing intentions
4. Treatment, especially mounting, dismantling, dealing with and exploring of products made of thoriated alloys
5. Exploitation, utilisation and manufacturing of pyrochlore ores
6. Utilisation and manufacturing of slags resulting from smelting copper slate ores

Annex XII

(concerning §§ 97 - 102)

Utilisation and Removal of Residuals to be observed

Part A: List of residuals to be observed

1. Slugs and precipitations resulting form oil and gas exploitation;
2. Phosphogypsum not treated and slugs resulting from their treatment as well as dusts and slags resulting from treatment of raw phosphate (Phosphorite);
3. a) Auxiliary rocks, slugs, sands and dusts resulting
   - from exploitation and treatment of Bauxite, Columbite, Pyrochlore, Microlithe, Euxenite, Copper Slate-, Tin-, Rare-Earth- and Uranium ores
   - from treatment of concentrates and residuals occurring during exploitation and treatment of these ores and minerals

   b) Minerals being equivalent to the ores mentioned before, which are occurring during exploitation and treatment of other raw materials;
4. Dusts and slugs resulting from smoke purification in the frame of primary smelting pig-iron and non-ferrous metallurgy.

Residuals according to § 97 are also

a) materials due to 1 ff., if the occurring of these materials is done by intention
b) waste pieces resulting from materials mentioned in 1 ff.
c) excavated or carried off soil and rubble resulting from pulling down buildings or other installations, if those are containing residuals due to 1 ff. and are removed after finishing work according to § 101 or from premises according to § 118

No residuals according to § 97 are materials due to number 1 to 4,

a) whose specific activity concentration for each radionuclide being part of the U-238- and Th-232-decay-chain is lower than 0.2Bq/g
b) which are taken as raw materials for the technical processes described

The daughter nuclides of the U-238- and Th-232-decay-chain as well as from the special Pb-210-decay are listed in annex III table 2 *[not delivered]*.

Part B: Supervision of residuals according to part A

1. In the frame of utilisation and removal of residuals the representatively determined values for $c_{U\text{-}238max}$ and $c_{Th\text{-}232max}$ as the highest levels of specific activities for radionuclides of the U-238- and Th-232-decay-chains are bound to the following total formula given in [Bq/g]:

   $$c_{U\text{-}238max} + c_{Th\text{-}232max} \leq c$$ with c as supervision limit = 1 Bq/g

2. Deviating from number 1, c is fixed at c = 0.5 Bq/g
   if more than 5,000t of residuals are annually deposited in the influence area of an utilisable groundwater reservoir
   or
   if residuals according to Part A are added of more than 20% to building materials or of more than 50% as utilisation in the frame of road constructions, landscape constructions or hydraulic engineering as well as athletic grounds or playgrounds.
3. Deviating from number 1, c is fixed at c = 5 Bq/g for underground utilisation or deposition of residuals.

4. In case of 5 times exceeding (factor a) the specific activities of all other radionuclides being part of the U-238-decay-chain by the highest Pb-210- and daughter-nuclide-concentrations, the following total formula must be applied:

$$r * c_{U\text{-}238max} + c_{Th\text{-}232max} \leq c$$

The factor r is fixed at 0.5 for utilisation or removal above the ground. In case of underground utilisation or removal the factor r is fixed according to the following table:

Factor a	Factor r
$5 < a \leq 10$	0.3
$10 < a \leq 20$	0.2
$20 < a$	0.1

5. Deviating from number 1 and 2, the following conditions must be fulfilled

$c_{U\text{-}238max} \leq 0.2$ Bq/g and $c_{Th\text{-}232max} \leq 0.2$ Bq/g,

if an influence area of an utilisable groundwater reservoir is covered in dimensions of more than 1 hectare by deposited auxiliary rocks or in the frame of utilising auxiliary rocks for road constructions, landscape constructions or hydraulic engineering as well as athletic grounds or playgrounds. If the specific activity concentration for each radionuclide being part of one of the U-238- or Th-232-decay-chain is lower than 0.2Bq/g, the respective decay-chain is not considered.

Part C: Assumptions for discharging from supervision in case of common deposition of residuals to be observed and other residuals and waste materials

In case of decisions according to § 98 (2) to be made for discharging residuals from supervision and resulting in a common deposition with other residuals and waste materials, the respective authority can assume an effective dose lower than 1mSv/a for single persons being members of the public resulting from common deposition without any further measures if the following requirements are met:

1. The mean values $c^{M}_{U\text{-}238max}$ and $c^{M}_{Th\text{-}232max}$ for specific activities of the radionuclides being part of the U-238- and Th-232-decay-chains are bound to the following total formula given in [Bq/g]:

$$c^{M}_{U\text{-}238max} + c^{M}_{Th\text{-}232max} \leq c^{M}.$$

The mean values $c^{M}_{U\text{-}238max}$ and $c^{M}_{Th\text{-}232max}$ for specific activities can be taken as the total activity of all residuals to be observed according to part A and B occurring within 12 months divided by the total mass of all residuals and waste materials dumped on this site in this period.
For the total activity determination, the highest radionuclide activity of the U-238- and Th-232-decay-chains are to be taken into account. c^{M} is defined as:

$c^{M} = 0.05$ Bq/g for dump sites with an area of more than 15 hectare
$c^{M} = 0.1$ Bq/g for dump sites with an area smaller than 15 hectare
$c^{M} = 1$ Bq/g independent of the dump site area for dump sites with specific conditions in order to prohibit influences of groundwater reservoirs
$c^{M} = 5$ Bq/g for underground removal

In frame of these calculations no activity concentration of any radionuclide being part of the U-238- and Th-232-decay-chains is allowed to exceed 10 Bq/g respectively 50 Bq/g for dumping on special sites, which are designed for residuals to be especially observed.

2. In case of 5 times exceeding (factor a) the specific activities of all other radionuclides being part of the U-238-decay-chain by the highest Pb-210- and daughter-nuclide-concentrations in one residual-

charge, the determination of the total activity according to 1. can be undertaken by multiplying the activity of the radionuclides being part of the U-238-decay-chain with a factor r. In case of removal on dumping sites, factor r is defined as 0.3. In case of underground removal factor r is defined according to the table of part B, number 4.

If the specific activity concentration in residual-charges for each radionuclide being part of one of the U-238- or Th-232-decay-chain is lower than 0.2Bq/g, the respective decay-chain is not considered in frame of calculating the total activity according to number 1 for this residual-charge.

Part D: Basics for determining radiation exposures resulting from residuals according to part A

1. In frame of determining the radiation exposure of single persons being members of the public realistic exposure paths are to be taken. *[...]*
2. In case of utilisation of residuals, all exposures, which can occur on the assigned utilisation way, especially by producing and distributing products and by removing residuals occurring in doing so, must be taken into account for determining the radiation exposure of single persons being members of the public.
3. In case of removing of residuals, all exposures, which can occur on the assigned removing way by treatment, storage and deposition of the residuals, must be taken into account for determining the radiation exposure of single persons being members of the public.
4. For premises being polluted by residuals, all exposures, which can occur under realistic using conditions and natural site conditions, must be taken into account for determining the radiation exposure according to § 101 (2).