

THE NEW GERMAN RADIATION PROTECTION ORDINANCE

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1 Introduction

According to European law, the Basic Safety Standards (BSS) /EU 96/ published by the European Council in 1996 and the Council Directive on health protection of individuals against dangers of ionizing radiation in relation to medical exposure /EU 97/ had to be transferred into national law within due time. In 2001 the new Ordinance for the Implementation of the Euratom Guidelines on Radiation Protection /STR 01/ was published, which replaces the old Radiation Protection Ordinance /STR 89/. The Ordinance had been worked out by the Federal Government under participation of several Federal Ministries and of expert committees in charge. The draft was commented by associations and organisations taking influence on several regulations. Finally it was passed by the “Chamber” of the Federal States (Bundesrat) applying some changes.

The new German Ordinance adapts the European Directive to German law, covering the general principles but even giving more details in many fields of radiation protection. The scope of the BSS is laid down in Article 2:

1. This Directive shall apply to all practices which involve a risk from ionising radiation emanating from an artificial source or from a natural radiation source in cases where natural radio nuclides are or have been processed in view of their radioactive, fissile or fertile properties, namely:
 - a) the production, processing, handling, use, holding, storage, transport, import to and export from the Community and disposal of radioactive substances;
 - b) the operation of any electrical equipment emitting ionising radiation and containing components operating at a potential difference of more than 5 kV;
 - c) any other practice specified by the Member State.
2. In accordance with Title VII it shall also apply to work activities which are not covered by paragraph 1 but which involve the presence of natural radiation sources and lead to a significant increase in the exposure of workers or members of the public which cannot be disregarded from the radiation protection point of view.
3. In accordance with Title IX it shall also apply to any intervention in cases of radiological emergencies or in cases of lasting exposure resulting from the after-effects of a radiological emergency or a past or old practice or work activity.
4. This Directive shall not apply to exposure to radon in dwellings or to the natural level of radiation, i.e. to radio nuclides contained in the human body, to cosmic radiation prevailing at ground level or to aboveground exposure to radio nuclides present in the undisturbed earth's crust.

This scope certainly is much broader than the prescriptions important for the field of radiation protection in nuclear power plants. According to the scope of this workshop on occupational exposure in nuclear power plants - and as the BSS most probably will be quite familiar to all of you - after a short general overview on relevant contents of the German Ordinance, this presentation will focus on the main issues important in the operation of NPP and especially on some areas which may give rise to necessary changes caused by the new Ordinance.

2 Overview on the Radiation Protection Ordinance

In its new form, the Ordinance covers the following main sections:

- **General regulations**

This section covers the purpose and scope of the Ordinance and the definitions. For instance in this part the conceptual distinction between “practices” involving radiation from (in general) artificial sources and “work” activities with the presence of radiation from natural sources is defined¹.

- **Protection of man and environment against radioactive substances or ionising radiation due to practices**

This section covers essentially:

- Basic principles of radiation protection and general limits, as e.g. justification, limitation and optimisation;
- Authorisation for
 - possessing, handling of radioactive substances and for equipment generating ionising radiation,
 - transport of radioactive substances,
 - transboundary shipment of radioactive substances,
 - medical research,
 - undertakings providing occupationally exposed personnel to operators,
 - clearance;
- Type approval regarding apparatus with radioactive sources or generating ionising radiation,
- Exemptions from the need of a license or approval.
- For these fields the criteria and requirements for practices needing no authorisation as well as the conditions and prerequisites for an authorisation are laid down.
- Requirements for practices

This section covers the necessary qualification and training in radiation protection, organisation of radiation protection, the protection of persons in radiation areas as well of man and environment against exposure, the protection against significant safety related events, dose limits, work-related medical provisions for occupationally exposed persons, procedures for radioactive waste and other requirements covering e.g. storage and safeguarding of radioactive substances, measuring devices, handing over of radioactive substances including documentation and accounting.

- **Protection of man and environment against natural sources of radiation due to work activities**

For the first time (apart from the nuclear fuel cycle) in Germany, regulations regarding exposures to enhanced natural radioactivity are incorporated into the Ordinance:

- The basic requirements regarding dose limitation and restriction,
- The requirements in case of terrestrial radiation at work-places:
 - Criteria for reporting if the exposure of personnel may exceed 6 mSv/year, and protective measures are dealt with. The dose limits are the same as set for occupationally exposed personnel performing practices (see chapter 3).
- Protection of the public against naturally occurring radioactive material:
 - Criteria and requirements regarding radioactive residues - resulting from work activities with natural radioactive material - which need surveillance are defined. It also binds the producer to remove these residues after the end of his work activities to make this area usable for other purposes. The criterion for further unconditional use is a dose limit of 1 mSv/year to the individual.

¹ The Ordinance distinguishes “Tätigkeiten” and “Arbeiten”.

“**Tätigkeiten**” are defined as operation of facilities to generate ionising radiation, as addition of radioactive substances during production or activation of such products, and as all other activities which may increase exposure or contamination during handling artificial radioactive substances or natural radioactive substances, if handled because of their radioactivity. This will be translated as “practices”.

“**Arbeiten**” are defined as increasing the exposure due to natural radiation without being ‘practices’ as defined above. This will be translated as “work activities”

- **Cosmic radiation:**
Regarding the protection of flight personnel against cosmic radiation the scope of surveillance and dose assessment (ambient dose calculation), the dose limits and the requirements for documentation are defined. Also in this field the dose limits are aligned to the limits set for occupationally exposed personnel in practices.

- **Protection of the consumer against the addition of radioactive substances to products**
The products for which deliberate addition of radioactive substances or activation is forbidden and the requirements for those products for which deliberate addition or activation will need an authorisation are defined. The prerequisites for an authorisation are connected to activity limits derived from exemption and clearance values. Transboundary shipment of such products also needs authorisation.

- **Common requirements**
Requirements common for practices and for work activities are defined, in particular
 - exposures to be taken into account,
 - national dose registry,
 - interim regulations regarding continued practices according the old ordinance and demarcation against other regulations.

Much information and data is added to the Ordinance in the form of enclosures covering e.g. the definition of practices not needing reporting or authorisation and the necessary data to be forwarded for application of an authorisation.

The most important ones are

- the tables defining the exemption limits, clearance levels, values of the surface contamination,
- requirements for the clearance of radioactive material,
- parameters and maximum concentrations for radio nuclides discharged from facilities into air or into water including calculation procedures.

3 Regulations important for NPP-operation and issues to be solved

The issues with some relevance for nuclear power plants (NPP) will cover the new dose limits, other reference levels and the clearance to be met by the utilities during operation or dismantling, and the protection measures for outside workers. Emphasis is given to the need of changes in organisation, planning and personnel management in comparison to the regulations according to the “old” Ordinance /STR 89/.

3.1 Dose limits

Regarding these limits, new dose limits to the public as well as to occupationally exposed personnel have to be considered. In both fields implications may be expected. The limits in this presentation mainly will be discussed taking the effective dose as a reference, as this is the reference chosen also in the BSS with additional limits for the equivalent dose for the eye’s lens and the skin. In Germany, due to historical reasons and with the argument to limit any potential higher exposure of some organs, additionally limits for the equivalent doses of organs have to be met for the public and for occupationally exposed persons. These will not be addressed in detail, but are summarised in a table in the annex to this paper (see chapter 6.1).

- **Doses to the public**

The dose limit for the effective dose to persons of the public has been set to 1 mSv/year according to the BSS. Additionally there are dose limits laid down for the (operational) discharges from facilities which call for keeping the effective dose of members of the public below 0,3 mSv/year, with additional limits set for organ doses (see table 3-1). These limits have to be met outside the facility’s area (Betriebsgelände). This area is not necessary limited by the site’s fence, but defined as the developed site where the facility is located and to which its responsibility for radiation protection is empowered to limit access and residence time.

Table 3-1 Dose limits to protect members of the public

Members of the public,	
General limit, effective dose	1 mSv/y
(Sum of exposure due to direct radiation and discharges; for direct radiation, whole stay for 1 year in general)	
Dose limits for radioactive discharges	
Effective dose	0,3 mSv/y
Organ dose: ovary, uterus, bone marrow	0,3 mSv/y
Organ dose: colon, lung, stomach, bladder, breast, liver, thyroid	0,9 mSv/y
Organ dose: bone surface, skin	1,8 mSv/y
(For discharges into the air or water, respectively)	

Compared to the old Radiation Protection Ordinance /STR 89/, the dose limits for the discharges have not been changed. The value of the general limit, which had been 1,5 mSv/year has been replaced by 1 mSv. For calculation, a steady stay all over the year (8760 hours) has to be taken into account, if no reliable data for the residence time of persons are available.

To allow for the superposition of the exposure due to discharges and to direct radiation, as a consequence the dose rate from direct radiation at the area of the site needs to be evaluated thoroughly. Theoretically the direct radiation from the site should be restricted to about 0,4 mSv/year with a mean dose rate of about 0,05 μ Sv/h, if the utility can not assure time limitations for the presence of persons and doses from releases would be close to the limits, which is not the case.

The fact, that actually the plants only exhaust the discharge limits to less than one percent hardly will help to increase the dose rates from direct radiation in practice.

In practice higher dose rates are possible by considering realistic residence times; but in some cases additional measures may be necessary as for instance improved shielding in critical areas or special planning, if e.g. the site is used for interim storage of radioactive material.

For companies which will detach personnel to work as occupationally exposed persons (outside workers or contracted personnel) in nuclear facilities, the reduced 1 mSv/year limit also implies more clarification and may have a consequence: An authorisation has to be applied for to detach personnel, if the effective dose of the person may exceed 1 mSv/year. Dose limits and radiation protection measures for this personnel apply in the same way as for utility personnel (see tables 3-4 and 3-5). The outside company has to equip each worker with a registered radiation passport covering all exposures for the worker.

- **Delineation of areas with potential exposures on site**

The borders of the site area to some extent may be considered the „borderline“ between members of the public and the group of persons exposed by their practices on site. The new Ordinance applies for lower thresholds for areas with potential exposures or dose rates(see table 3-2). As an overview, figure 3-1 gives an schematic presentation of the areas defined on site and the integration into the company's and the public area.

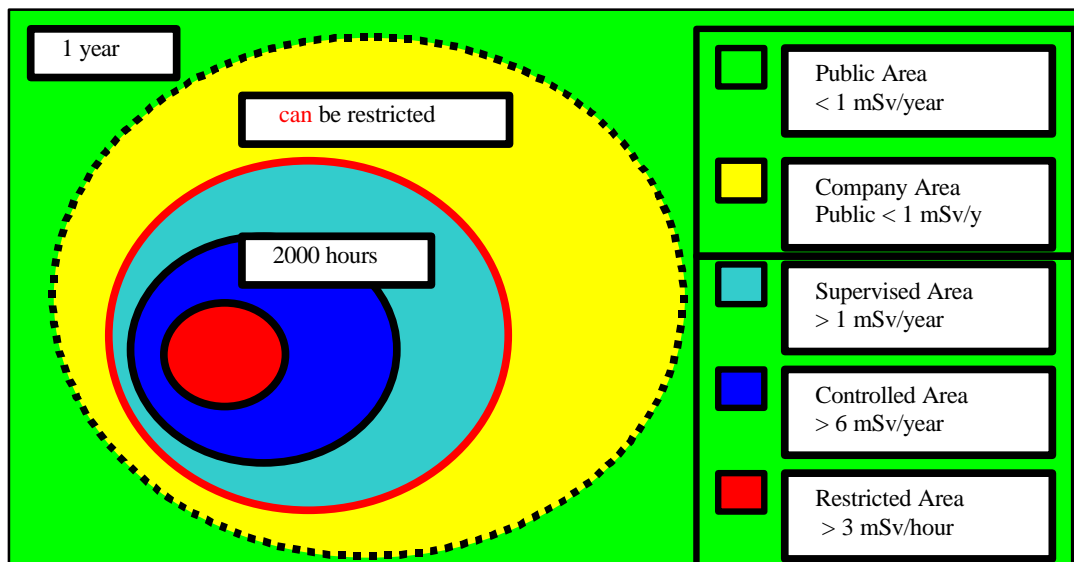


Figure 3-1 Definition of areas on- and off site; the dashed line defines the company’s area, which allows access of the public, but where the company has the power to restrict the access of the public to less than 1 year. Residence times indicated are applied if no data are available, but smaller values may be granted, if they can be proven.

Table 3-2 Delineation of radiological areas with potential exposures beyond 1 mSv/year effective dose (Organ doses according to BSS see table in the annex)

“Supervised area“	
Effective dose	> 1 mSv/y
“Controlled area“	
Effective dose	> 6 mSv/y
“Restricted area”	
Dose rate	> 3 mSv/h

The “restricted area” is a specific German criterion requiring additional access and monitoring measures; this requirement is unchanged from the old Ordinance.

For supervised and controlled areas a working/residence time of 40 hours a week and 50 weeks per year is assumed resulting in a theoretical work time of 2000 hours, if no other conditions can be proven.

Practical consequences may result from

- the limitation of effective dose to 1 mSv/year on the company’s area (with reduced residence time of 2000 h) for persons working in this area. This issue will be addressed in the chapter on dose limits for occupationally exposed personnel;
- The reduction of the dose threshold for the supervised area from formerly 5 mSv/year to the new value of 1 mSv/year;
- the reduction of the dose threshold for the controlled area from formerly 15 mSv/year to the new value of 6 mSv/year.

Table 3-3 Dose rates derived from dose limits (if no exposures due to discharges are considered), assuming 2000 hours residence time

Public areas around the company’s area (total dose rate)	< 0,11 µSv/h
Company’s area, not radiologically surveyed	0,11 µSv/h to < 0,5 µSv/h
Supervised area	0,5 µSv/h to < 3 µSv/h
Controlled area	> 3 µSv/h (to 3 mSv/h)
Restricted area	> 3 mSv/h

Reducing the limit for the controlled area should not imply severe modifications in constructive areas of the plants, as normally in NPPs the borders of the controlled area are not limited by the dose rate, but by constructive boundaries. There are, however, areas where these reductions are to be considered, e.g. areas on

site with temporary storage of radioactive waste or loaded fuel flasks, which may need some delimitation due to higher dose rate.

A working group of radiation protection specialists from the Vereinigung der Grosskraftwerkbetreiber (VGB, Association of large power plant operators) has developed some concepts /VGB 01/ to transfer these regulations into practice.

For areas outside the company's influence:

If dose rates are below 0,11µSv/hour the dose limit is considered as being met; for dose rates near or above this value detailed considerations are recommended:

- In inhabited areas, designated living areas, mixed areas and camping areas steady residence (8760 hours) has to be assumed;
- In commercial areas a maximum residence time of 2000 hours (work time 40 hours 50 weeks) could be assumed;
- In rural and forestall areas a more limited residence time of 400 h may be assumed resulting in an average dose rate of 2,5 µSv/h.

As a superposition of doses for a single person in all areas considered can not be excluded, the sum over an assumed residence in all 3 areas should not be higher than 1 mSv. Additionally an exposure due to operational discharges needs to be considered in the resulting dose.

For areas inside the company's influence, this means in the company's area,

- the existing delimitation of supervised and controlled areas basically need not to be changed;
- care should be taken that outside of a controlled area doses higher than 1 mSv can not occur without being recognised and accounted.
- areas with continuous dose rates > 0,5 µSv/h outside the controlled area in any case will be restricted of or at least marked to assure that the dose limit of 1 mSv can be met for residence times of 2000 h. In case of practices carried out in these areas, dosimeters have to be used or the dose has to be assessed by other ways. In some cases also restrictions of residence times may be applicable.

Evaluations in NPPs have shown that these procedures are practicable and compatible with the existing situation at the sites.

Further consequences to be considered will be discussed in the following chapter in the context of the dose limits to occupationally exposed persons on site.

- **Dose limits for personnel and for visitors in nuclear power plants**

The personnel defined as “occupationally exposed personnel”, other workers and visitors need to be considered.

Table 3-4 Occupationally exposed personnel

Categorisation of occupationally exposed personnel	
Category A	
Effective dose	> 6 mSv/y
Organ dose: eye lens	> 45 mSv/y
Organ dose: skin, hands, arms, feet, ankle	> 150 mSv/y
Category B	
Effective dose	> 1 mSv/y
Organ dose: eye lens	> 15 mSv/y
Organ dose: skin, hands, arms, feet, ankle	> 50 mSv/y

These dose thresholds follow the BSS. Compared to the old German regulation there are two main changes:

- The dose thresholds of the two groups of occupationally exposed personnel defining the category has been significantly reduced (5 mSv to 1 mSv for category B, 15 mSv to 6 mSv for category A Personnel);

- The former group of occupationally exposed personnel not categorised, but allowing exposure up to 5 mSv/year /STR 89/ does no longer exist. In practice for this group a limit has been set to 1 mSv/year as to members of the public.

As a consequence in practice the groups have been “scaled down” with all persons potentially receiving doses beyond 1 mSv/year being designated at least to group B. As given in the BSS, the main difference between category A and B-personnel is the way of dose assessing and medical surveillance. Considering this difference, the “upgrading” of personnel from category B to category A in case of need might be possible, but will not be a practical solution due to the formalism and the time necessary.

Though seeming of less importance, the lowering of the dose threshold for personnel of category B (or the “dose limit” for non categorised occupationally exposed personnel) will afford some consideration on site for the utility personnel and also for a certain group of contracted personnel.

- According to the old Radiation Protection Ordinance for utility personnel and other persons working on site not dedicated to routinely work linked exposure, as e.g. clerical personnel, guards,....., could be exposed to a maximum of 5 mSv/year as uncategorized occupationally exposed personnel. This procedure is no longer possible with the need either to assure that this group of personnel will meet a dose limit of 1 mSv/year or to define them as occupationally exposed personnel of category B. As mentioned above, the utilities tend to take care that the dose limit of 1 mSv/year can be met for this group, e.g. by assuring dose rates to less than 0,5 µSv/h in areas on site which are accessible for this personnel .
- For a certain group of contracted personnel detached from entities the situation is quite close, as it was possible to apply up to 5 mSv/year to persons not being occupationally categorised. Under the new Ordinance the plant needs to handle this group of personnel not to receive a dose exceeding 1 mSv/year. This will necessitate some special formal arrangement with the contractor and some special dose considerations or work restrictions for those workers. Or, as an alternative these persons would need to be assigned at least to category B with the additional consequence that the contractor’s-company would need a special license and has to file the exposures in a radiation passport.

Visitors as members of the public will have to keep a dose limit of 1 mSv/year. To be sure to meet this regulation, utilities have considered a lower internal limit to be met for visitors in the plant.

The dose limits for occupationally exposed personnel are shown in table 3-5 according to the Radiation Protection Ordinance which applies additional dose limits for organ doses compared to the BSS.

Table 3-5 Dose limits for occupationally exposed personnel

Effective dose	20 mSv/y*
Organ dose: eye lens	150 mSv/y
Organ dose: skin, hands, arms, feet, ankle	500 mSv/y (each)
Organ dose: ovary, uterus, bone marrow	50 mSv/y (each)
Organ dose: thyroid, bone surface	300 mSv/y (each)
Organ dose: colon, lung, stomach, bladder, breast, liver, oesophagus	150 mSv/y (each)
<i>*The authorities may permit a limit of 50 mSv/a with the limitation of 100 mSv over the period of the following 5 years</i>	

The 20 mSv/year limit has been adopted as common practice, but the exception of 50 mSv/year with an average of 20 mSv/year over 5 years may be granted by special agreement of the authorities. Actually the data show, that for utility personnel in nearly all German NPPs the new limit should not be a problem. For contracted personnel in some areas this may afford special personnel deployment planning to keep the 20 mSv/year-limit, although plant specific data also for this personnel show that the contribution to the exposure of contracted personnel in most of the NPPs is quite low.

Additional dose limits are defined for special groups of persons due to age, training needs or due to sex to protect unborn children and breast fed babies.

Table 3-6 Dose limits defined for the occupational exposure of special groups of the public (effective dose presented only)

Persons less than 18 years old	
Effective Dose	1 mSv/y
Trainees, students, aged 16 to 18, by agreement of the authorities	
Effective Dose	6 mSv/y
Women who may become pregnant	
Uterus Dose	2 mSv/month
Women who are pregnant	
Internal and external dose over time of pregnancy <u>no incorporation</u> -> no employment in controlled areas of NPPs with presence of radioactivity	1 mSv
Career dose for occupationally exposed persons	
Effective dose over sum of all work time	400 mSv

For persons less than 18 years, for trainees aged 16 to 18 years and for the protection of the unborn child these limits follow the guidance of the BSS.

Special German regulations are the limits set for women who may become pregnant to assure some additional protection in case of pregnancy until it is recognised and the career dose limit which was taken from the old Radiation Protection Ordinance, which, however, - as a well known regulation - will not cause any conflicts and which has some exception regulation if personnel should exceed this limit.

The limit for women who may become pregnant will need special dose assessment. Additionally special information is necessary for this group. There are prescriptions to inform about the hazards of activity by internal contamination. Additionally it is prescribed that for women who have informed the utility that they are pregnant or breast feeding the work conditions have to be set in a way that incorporation of radio nuclides is excluded.

As a practical proposal, additionally to the necessary information of special groups of the personnel, in /VGB 01/ it is proposed for all workers to set an internal limit of about 80 % of the official dose limit and additionally to set the daily dose budget to about 10 % of the dose limit to be able to plan and manage dose development of the staff in due time.

- **Dose limits for specially authorized exposures of workers category A**

To complete the field of dose limits, two additional cases according to Article 12 and Article 52 of the BSS, are to be listed.

Table 3-7 Special dose limits set for special work

Special work (dose limit)	
Effective dose	100 mSv/y
Organ dose: eye lens	300 mSv/y
Organ dose: skin, hands, arms, feet, ankle	1000 mSv/y
Agreement of authorities and personnel necessary	

Table 3-8 Special dose levels recommended for life saving actions

Life saving actions (reference level, no limit)	
Effective dose (once a year)	100 mSv
Effective dose (once in life time)	250 mSv

Details of regulations for specially authorized exposures are as prescribed by Article 12 BSS. . It has to be stressed that in the case of life saving actions the dose values indicated are not considered as limits, but more as a recommendation.

To some extent, both regulations cover cases which are more hypothetical. For the operation of a NPP this should be an exception and should not create special restrictions. For the utilities it is, however, considered to derive a concept for information of volunteers.

3.2 Exemption values

In table A to its Annex I the Basic Safety Standards lay down exemption values defined as activities and as specific activities for a large number of nuclides, which give the criteria for exemption from reporting or authorisation. This table has been integrated into the German Ordinance /STR 01/ and has been expanded to a large number of additional nuclides derived by the National Radiation Protection Board (NRPB) /NRPB 98/ .

An example is given in table 3-9 showing the full scope of additional data integrated which cover regulations dealt with in the next chapters. The data for Co 60 are presented as an example for the criteria chosen.

Table 3-9 Regulation contained in the new German Ordinance regarding exemption, surface contamination and clearance. Additional conditions and regulation have to be considered for these regulations (see chapters 6.2 and 6.3 in the annex of this paper)

Nuclide	Exemption Bq	Exemption Bq/g	Surface cont. Bq/cm ²	Solid/Liquid Bq/g	Building rubble Bq/g	Soil Bq/g	Building re-use Bq/cm ²	Solid/Liquid Bq/g	Building dism. Bq/cm ²	Metal scrap Bq/g	Half-life
Co60	1E5	1E1	1	0,1	9E-2	3E-2	4E-1	4	3	0,6	5,3 y
	Exemption values			Clearance values unconditional release			Clearance values conditional release				

Basically the large number of nuclide specific values defined afford the superposition of nuclides which is done by a the summation formula

$$\sum_i \frac{\text{value considered or measured}_i}{\text{value from table}_i} \leq 1$$

to account for the relative normalised sum over all relevant nuclides i for the item to be evaluated as e.g. activity, specific activity or surface contamination. In practice this will call for some effort, as in a nuclear power plant a specific nuclide vector prevails. This nuclide vector needs to be evaluated and implemented into the measurement. In practice this will be done by specific calibration of the measurement devices. With time, the nuclide vector has to be checked for changes due to operation or changes of conditions and in case re-calibration has to be performed.

3.3 Surface contamination

The table lists values for surface contamination which will be used as a basis for the clearance of material (see chapter 3.4) and to set maximum values for the surface contamination in different areas including tools and apparatus on and off site. As mentioned in chapter 3.2, the summation formula has to be applied for nuclide vectors.

Table 3-10 Multipliers to be applied to calculate the limits for surface contamination in different areas on and off site

Area or material	Multipliers to be applied to the value given for surface contamination
Controlled area	100
Supervised area	10
Company area	1
Material to be released from controlled area (<i>specific activity to be checked too</i>)	1

3.4 Clearance for re-use, recycling and disposal

Criteria for the release of usually slightly contaminated or activated material from the requirements for radioactive substances have been defined in the Radiation Protection Ordinance. Related clearance values for different ways of recycling or re-use and disposal have been integrated into the Ordinance as can be taken from table 3-9. As possible pathways the unconditional use of the material, and the conditional use, understood as disposal in a refuse disposal site, incineration or conditional recycling by melting are considered. This consideration and data are also related to the contamination of work-places, clothes and material on site and the transfer of such material (e.g. tools, instruments,..) from the controlled area for use outside controlled areas.

Regarding the clearance of radioactive material for unconditional or conditional use, an approval of the authorities will be necessary. It will be granted, if as a consequence of the release a member of the public only may receive a dose of about 10 $\mu\text{Sv}/\text{year}$. The authority can assume that this dose criteria will be met, if the values defined in table 1 of annex III of the Ordinance (see example in table 3-9) are not exceeded and some additional conditions are fulfilled, which are defined in several sections of annex IV of the Ordinance. Some information on the values laid down and the additional conditions and considerations can be found in the annex of this paper (see chapter 6.3). All radioactive material not meeting these conditions for unconditional or conditional release certainly will have to be conditioned and disposed off as radioactive waste.

In the new Ordinance the first time in Germany a complete set of data has been laid down to regulate the release of radioactive material, building and areas from the surveillance due to the Atomic Law or the Radiation Protection Ordinance. Certainly this regulation has some advantage, as it clarifies the procedures, levels and conditions and so to some extent hopefully simplifies the formalisms and the handling of this slightly radioactive material.

For solid material with measurable surfaces, both levels for surface contamination and specific contamination have to be met, putting some effort into the measurement with large surfaces. Additionally material properties may cause some problems: for material with low specific weight, as e.g. insulation material, the masses may be significantly lower than e.g. for steel, which may give a higher specific activity and a higher volumetric relation.

In practice special measuring chambers of different sizes are able to proof the specific activity levels of the material to be released. This holds for operating plants and for plants under decommissioning. Practice also has been gained in the release of buildings and of soil areas by contamination monitoring and in situ-contamination monitoring of large areas and also of contaminated soil by specific activity measurement e.g. in Greifswald.

Though some effort needs to be taken in some areas, the system has proven its applicability and effectiveness in practice to handle the release of material with limited content of radio nuclides.

4 Summary

The presentation gave a short overview of the new German Ordinance for the Implementation of the Euratom Guidelines on Radiation Protection. As it was impossible to go into all details of this new Ordinance, after the short survey on its structure and main contents the presentation concentrated on two issues which may be important as well for the operation and for the dismantling of nuclear facilities, focussing on dose limits and on clearance levels. Whereas the dose limits have undergone some important changes and reductions of values, guidance on the release (clearance) of low radioactive material either for unconditional use or for conditional use by recycling or by disposal has been implemented as a new, but comprehensive part into the new Ordinance.

Though some effort has to be taken by the nuclear power plants, it can be recognised that the implementation of the new regulation should not cause severe restrictions for the utilities, but in some cases may increase cost and in some cases also the amount of formalism necessary.

5 References

- /EU 96/ Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and of the general public against the dangers arising from ionizing radiation
Official journal No. L 159, 29.06.1996 p. 1 ff
- /EU 97/ Council Directive 97/43/EURATOM of 30 June 1997 on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure, and repealing Directive 84/466/EURATOM
Official journal No. L 180, 09.07.1997 p. 22 ff
- /NRPB 98/ Mobb, S.F., M.P. Harvey
Exempt concentrations and quantities for radio nuclides not included in the European Basic Safety Standards Directive
NRPB-R 306, Approved December 1998, Published April 1999
ISBN 0 85951 429 3
- /STR 89/ Verordnung über den Schutz vor Schäden durch ionisierende Strahlen (Strahlenschutzverordnung-StrlSchV),
in der Fassung der Bekanntmachung vom 30. Juni 1989
BGBl. I 1989 S. 1321, ber. S. 1926
- /STR 01/ Verordnung für die Umsetzung der EURATOM-Richtlinien zum Strahlenschutz vom 20. Juli 2001
BGBl. I 2001 S. 1714
- /VGB 01/ Praktische Umsetzung der Strahlenschutzverordnung vom 1. August 2001 in Kernkraftwerken
Interpretationshilfen und Empfehlungen des Arbeitskreises "Praktischer Strahlenschutz" der Vereinigung der Gross-Kraftwerksbetreiber (VGB)
Stand August 2001

6 Annexes

6.1 Dose limits defined in the new Ordinance,

Table 6-1 Protection of the public and of occupationally exposed persons

Reference	Dose Limit
Protection of the public	
Members of the public, dose limits	
Effective dose (<i>Sum of exposure due to direct radiation and discharges of radioactivity into the air and into water</i>)	1 mSv/y
Organ dose: eye lens	15 mSv/y
Organ dose: skin	50 mSv/y
Dose limits for radioactive discharges to protect the public	
Effective dose	0,3 mSv/y
Organ dose: ovary, uterus, bone marrow	0,3 mSv/y
Organ dose: colon, lung, stomach, bladder, breast, liver, thyroid	0,9 mSv/y
Organ dose: bone surface, skin	1,8 mSv/y
<i>Limits for discharges into the air and into water, respectively</i>	
Protection of occupationally exposed persons	
Categorisation of occupationally exposed personnel	
Category A	
Effective dose	> 6 mSv/y
Organ dose: eye lens	> 45 mSv/y
Organ dose: skin, hands, arms, feet, ankle	> 150 mSv/y
Category B	
Effective dose	> 1 mSv/y
Organ Dose: eye lens	> 15 mSv/y
Organ Dose: skin, hands, arms, feet, ankle	> 50 mSv/y
Dose limits for occupationally exposed personnel	
Personnel Category A	
Effective dose	20 mSv/y*
Organ dose: eye lens	150 mSv/y
Organ dose: skin, hands, arms, feet, ankle	500 mSv/y (each)
Organ dose: ovary, uterus, bone marrow	50 mSv/y (each)
Organ dose: thyroid, bone surface	300 mSv/y (each)
Organ dose: colon, lung, stomach, bladder, breast, liver, oesophagus	150 mSv/y (each)
<i>*The authorities may permit a limit of 50 mSv/a with the limitation of 100 mSv over the period of the following 5 years</i>	

Table 6-2 Protection of special groups of occupationally exposed persons

Reference	Dose Limit
Persons less than 18 years old	
Effective dose	1 mSv/y
Organ Dose: eye lens	15 mSv/y
Organ Dose: skin, hands, arms, feet, ankle	50 mSv/y
Trainees, Students	
Effective dose	6 mSv/y
Organ dose: eye lens	45 mSv/y
Organ dose: skin, hands, arms, feet, ankle	150 mSv/y
Women who may become pregnant	
Uterus dose	2 mSv/month
Women who are pregnant	
Internal and external dose over time of pregnancy	1 mSv
Career dose for occupationally exposed persons	
Effective dose over sum of all work time	400 mSv
Specially authorized exposures, (dose limits)	
Effective dose	100 mSv/y
Organ dose: eye lens	300 mSv/y
Organ dose: skin, hands, arms, feet	1000 mSv/y
Agreement of authorities and personnel necessary	
Live saving actions, (reference dose, no limit)	
Effective dose (once a year)	100 mSv
Effective dose (once in life time)	250 mSv

Table 6-3 Delineation of areas with potential exposures on site

Reference	Dose Limit
„Supervised area“	
Effective dose	> 1 mSv/y
Organ dose: eye lens	> 15 mSv/y
Organ dose: skin, hands, arms, feet, ankle	> 50 mSv/y
„Controlled area“	
Effective dose	> 6 mSv/y
Organ dose: eye lens	> 45 mSv/y
Organ dose: skin, hands, arms, feet, ankle	> 150 mSv/y
“Restricted area”	
Dose rate	> 3 mSv/h

Table 6-4 Incident reference levels for planning and design of technical protective measures against incidents (To be applied for the design of NPP, storage of nuclear fuel, and facilities of the Federal Government for confiscation and final disposal of radioactive waste)

Reference	Dose level
Effective dose	50 mSv
Organ dose: thyroid, eye lens	150 mSv
Organ dose: skin, hands, arms, feet, ankle	500 mSv
Organ dose: ovary, uterus, bone marrow (red)	50 mSv
Organ dose: bone surface	300 mSv
Organ dose: colon, lung, stomach, bladder, breast, liver, oesophagus	150 mSv
<i>Doses are to be calculated according to Guideline and cover exposure over 50 years including ingestion</i>	

6.2 Overview of release criteria of radioactive material for unconditional use, disposal and recycling

This annex gives a short overview over the contents of the table 1 in annex III of the Ordinance. The table heading and one entry for Co 60 are displayed for orientation..

Nuclide	Exemption Bq	Exemption Bq/g	Surface cont. Bq/cm ²	Solid/Liquid Bq/g	Building rubble Bq/g	Soil Bq/g	Building re-use Bq/cm ²	Solid/Liquid Bq/g	Building dism. Bq/cm ²	Metal scrap Bq/g	Half-life
Co60	1E5	1E1	1	0,1	9E-2	3E-2	4E-1	4	3	0,6	5,3 y
	Exemption values			Clearance values unconditional release				Clearance values conditional release			

The columns of the table contain:

- **Radio nuclides**, to some extent also special chemical forms of a specific nuclide;
- **Exemption values** for the nuclides defined as activities and specific activities
- **Surface contamination levels** to define,
 - (by certain multipliers) the maximum surface contamination for work-places and clothing in the controlled area, in the supervised area and outside;
 - the maximum surface contamination for objects which are transferred from the controlled area for use outside such areas (also specific activity criteria have to be met, see below);
 - the maximum surface contamination of solid waste for disposal and metal scrap for recycling (also specific activity criteria have to be met, see below) if the material has some fixed defined surface,
- **Specific activities for liquids and solid materials** (except building rubble and excavated material with masses > 1000 t per year) which give the specific activity limit
 - for objects which are transferred from the controlled area for use outside such areas (also surface contamination have to be met, see above);
 - for an unconditional release of solid material (criteria for surface contamination have to be met, see above);
 - for unconditional release of liquids.
- **Specific activities for building rubble and excavated material** of more than 1000 t/year for unconditional release of this material;
- **Specific activities for soil areas** for unconditional use
- **Surface contamination levels for building surfaces** for the release of buildings for unconditional use
- **Specific activities for liquids and solid materials** (except building rubble and excavated material with masses > 1000 t per year) which give the specific activity limit for conditional release
 - for disposal of the material (surface contamination limits have to be met) e.g. in a refuse disposal site
 - incineration of liquids;
- **Surface contamination levels for building surfaces** for the dismantling of buildings;
- **Specific activities for metal scrap for recycling** (surface contamination levels have to be met, see above).

6.3 Overview of additional conditions to be met and considered in the release of radioactive material in unconditional release, for disposal or recycling as defined in annex IV of the Ordinance

The important statements of annex IV of the Ordinance are listed to explain philosophy and boundary conditions for the release of radioactive material. It is not an exact translation of the respective annex of the Ordinance, if necessary the original document should be referred to.

- **General conditions**
 - If the surface of the material allows a surface contamination measurement, it has to be shown by measurement, that the surface contamination limits and the activity concentration limits are met (authority may allow other ways of proof).
 - The averaging mass for the measurement of the activity concentration shall be not significantly larger than 300 kg.
 - The averaging area for contamination measurement may be up to 1000 cm².
 - If several radio nuclides are present, a summation formula for the normalised contributions shall be applied for the specific activity and the surface contamination; nuclides need not to be considered, if the contribution of the neglected nuclides is less than 10 % of the normalised sum.
 - For radio nuclides in radioactive equilibrium, the daughter radio nuclides listed in a specific table may be neglected in the summation.
 - For those nuclides which are not listed in the table III, the values have to be calculated for the specific case; for nuclides with half lives less than 7 days or in case of small masses, the specific activity of the exemption level may be used for the release of solid or liquid material.
 - **Unconditional release**
 - The unconditional release covers no further commitments regarding the future use.
 - For building rubble and excavated material the values for solid material may be used, for unconditional release, if the mass is smaller than 1000 t/year.
 - **Release for disposal**
 - It is a prerequisite that the material will be implemented into the refuse disposal site without biological or chemical pre-processing or into an incineration plant and that a use of the material outside the refuse disposal site or incineration plant will be excluded.
 - The values given for “building dism.” do not apply for building rubble and excavated material if the mass may be larger than 1000 t/year.
 - **Release of buildings**
 - Measurements should be applied at the non destructed building and may be performed applying a spot check procedure.
 - the averaging area may be up to 1 m².
 - After release of a building arising building rubble e.g. from dismantling does not afford a separate release procedure.
 - In case of activation of the material resulting in a volumetric activity distribution, further prescribed criteria have to be applied.
 - **Release of contaminated soil areas**
 - The averaging area of the contaminated surface may be up to 100 m².
 - Only such contamination has to be considered, which was caused by the facility under consideration.
 - If no reference levels are defined, the proof of dose limitation to the public has to be performed by dose calculation based on contamination measurements.
 - The specific activity clearance level for soil may be re-calculated into a surface contamination level (surface level = specific level * soil density * mean penetration depth).
 - **Release of building rubble and excavated material**
 - The values given for building rubble and excavated material hold for material from practices in facilities in operation or from dismantling of a facility or its parts, if the prerequisites for clearance measurement at the intact building are not met.
 - The averaging mass for building rubble may be up to 1 ton (1 Mg); the authority may allow higher masses.
 - **Release of metal scrap for recycling**
 - It is a prerequisite for this release path that the scrap released will be molten.
- The values defined are not valid for compounds of metallic and non-metallic material.