CHANGING RELEASE CRITERIA FROM PAST TO PRESENT

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ABSTRACT

Beginning with the decommissioning of nuclear power plants the release, criteria for radioactive materials has gained importance significantly. After decommissioning and dismantling, most of the residues need not be treated as radioactive waste, since they contain only small amounts of radioactivity.

The Karlsruhe Research Center already dismantled two research reactors completely (the Karlstein Super Heated Steam Reactor and the Niederaichbach Nuclear Power Plant), while several additional decommissioning projects are currently in progress. About 70 % of the total waste mass within each project can be released from the area of atomic regulations and licenses. At the Niederaichbach and Karlstein sites the release procedures and the release criteria were determined in the decommissioning license, where issues such as controlling and release values were fixed. Additionally, each step of the release process has to be coordinated with the regulator.

Today the general release criteria are contained in the atomic act. Depending on the nature of the material to be released (e.g. building structures or metallic waste), and depending on the further use of the material, such as unrestricted reuse or waste disposal, release values for each nuclide are established. To prepare the release of materials, a release plan including the release measurement results is sent to the regulator, who has to officially approve the concept.

INTRODUCTION

The Radiation Protection Ordinance (RPO) (Strahlenschutzverordnung / StrlSchV) [1] has been issued on July 20, 2001. This Radiation Protection Ordinance transforms the EURATOM Basic Safety Standards [2] into national legislation. It contains, for the first time, detailed regulations on clearance including nuclide specific sets of clearance levels (CL) for all clearance options: unconditional clearance, clearance of building rubble (> 1000 Mg/a), clearance of buildings for demolition and for reuse, clearance of metals for recycling, clearance of nuclear sites, and clearance for disposal or incineration.

All clearance levels are based on the concept of triviality of dose, i.e. the clearance levels have been derived on the basis of 10 µSv/a individual dose. In addition, the assessments of collective dose for each clearance option show that the criterion of 1 man-Sv/a is well fulfilled. The clearance levels in Germany have always been derived in such a way to achieve maximum compatibility with the international development, especially in the European Union, but also with recommendations of the IAEA.

All sets of clearance levels are based on detailed radiological assessments which rely on comprehensive investigations and studies taking into account the distinctive features of the clearance options and the types of materials involved. Each radiological model consists of a variety of scenarios which take into account external irradiation, inhalation, direct and secondary ingestion and skin contamination and a number of pathways (workplaces, home, foodstuff, water pathways etc.). For each nuclide and each clearance option, a separate clearance level value exists in the German RPO.

CLEARANCE OPTIONS IN THE GERMAN RADIATION PROTECTION ORDINANCE (STRLSCHV)

The clearance options are defined in § 29 together with Annex III Table 1 of the German RPO. They consist of "unconditional clearance" (category 1 in the following list) where no restrictions exist concerning the destiny of the material after clearance, i.e. the material need not be traced to a final destination, as well as clearance for a specific purpose (category 2 in the following list) where it must be guaranteed that the material will be brought to the pre-defined destination. This latter category of clearance options is often called "conditional clearance" (a term which is no longer used in German legislation).

Clearance options are:

1. unconditional clearance
   a. of all solid materials for reuse, recycling or disposal including building rubble of less than 1000 Mg per year,

   b. of building rubble and soil of more than 1000 Mg per year,
   c. of buildings for reuse or demolition,
   d. of nuclear sites (after removal of the buildings);
2. clearance
   a. of solid materials for disposal on landfills or for incineration,
   b. of buildings for demolition only,
   c. of metal for melting only.

Table1 provides an overview of CL for a short selection of nuclides.

Table 1: Examples for CL in annex III table 1 of the German radiation protection ordinance

Nuclide	**Exemption level**		**surface specific activity** Bq/cm²	**Clearance**						
	activity in Bq	activity concentr. Bq/g		**unconditional clearance of**				**clearance of**		
				solids, liquids* Bq/g	rubble, soil of > 1000 Mg/a Bq/g	sites (land) Bq/g	build-ings for reuse Bq/cm²	solids, liquids for dis-posal* Bq/g	build-ings for demo-lition Bq/cm²	metal scrap for recyc-ling Bq/g
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*10a*
H 3	1E+9	1E+6	1E+2	1E+3	6E+1	3	1E+3	1E+3	4E+3	1E+3
C 14	1E+7	1E+4	1E+2	8E+1	1E+1	4E-2	1E+3	2E+3	6E+3	8E+1
Fe 55	1E+6	1E+4	1E+2	2E+2	2E+2	6	1E+3	1E+4	2E+4	1E+4
Co 60	1E+5	1E+1	1	0.1	9E-2	3E-2	4E-1	4	3	0.6
I 131	1E+6	1E+2	1E+1	2	6E-1	2E-1	1E+1	2E+1	6E+2	2
Cs 137	1E+4	1E+1	1	5E-1	4E-1	6E-2	2	1E+1	1E+1	6E-1
U 234	1E+4	1E+1	1	5E-1	4E-1		1	9	1E+1	2
Pu 242	1E+4	1	1E-1	4E-2	4E-2	4E-2	1E-1	1	2	3E-1
Am 241	1E+4	1	1E-1	5E-2	5E-2	6E-2	1E-1	1	3	3E-1
**) for col. 5 and col. 9: only for material which does not fall under column 6*										

CLEARANCE LEVELS AT THE DECOMMISSIONING OF THE NIEDERAICHBACH AND KARLSTEIN RESEARCH REACTORS

With the Niederaichbach Nuclear Power Plant and the Karlstein Superheated Steam Reactor two nuclear facilities are already decommissioned completely. The decommissioning took place, before the clearance levels of the new German Radiation Protection Ordinance were valid. Nevertheless, it was possible to release material for the

further unrestricted use. The clearance levels were issued in the decommissioning license of both sites and were based also on the 10-µSv-concept, that ensures that no individual receives any dose higher than 10 µSv/a from the released material. Basis for the determined clearance levels was 10^{-5} of the exemption levels [Bq/g] of the old Radiation Protection Ordinance.

Before the release can take place, a few preparation must be done:

- Characterization based on "Finger Prints" from operational history and contamination paths from dismantling
- Determination of room sequences, areas, coding and enumeration of measurement sections
- Removal of floor mortar layers or coating
- Identification of hot spots and presumably uncontaminated sections
- Demarcation of sections, rooms and stories to prevent spread of contamination

The clearance procedure contains the following steps:

- Sampling to determine the penetration depth of contamination
- Determination of decontamination steps based on hand-held monitor measurements, smear tests and samples
- Decontamination and control measurements
- Final vacuum of dust, cleaning and room sealing
- Decision measurements and evidential back sampling

Table 2 and 3 show the areas which were measured at the Niederaichbach and Karlstein site for clearance.

Table 2: Clearance area at the decommissioning of the Niederaichbach Nuclear Power Plant

	Clearance Areas	Number of Measurements
Control Area (CA)	26,000 m² Walls, Floors and Roofs	200,000 with Portable Monitors 5,000 Samples
Outside CA	19,500 m² Buildings, Roads and Soil	2,300 with Portable Monitors 300 Samples

Table 3: Clearance area at the decommissioning of the Karlstein Superheated Steam Reactor

Building	Metal	Concrete	Soil	Total
Reactor building	11,734	17,002	-	28,736
Auxiliary building	2,190	7,137	-	9,327
Working buildings, controlled area	182	510	-	692
Working building	1,050	7,447	-	8,497
Buildings outside controlled area	8,930	9,808	-	18,738
Areas outside controlled area	233	3,159	3,169	6,561
Total	**24,319**	**45,063**	**3,169**	**72,551**

The measurement methods, sufficient for the later on release, was determined by the surveyors. Mostly the analyses of the activity was done by a direct contamination measurements and by taking drill samples.

As mentioned before, the clearance levels was determined in the decommissioning license. Table 4 shows some release values, important for the release of material at the Karlstein site.

Table 4: Release values for Karlstein decommissioning project and the activity distribution for different material

Nuclide	**Exemption Level [Bq]**	**$5 \cdot 10^{-5}$ of Exemption Level [Bq/g]**	**Activity Distribution [%]** Biological Shield	**Activity Distribution [%]** Concrete structures of reactor building
Co-60	5 E + 5	25	3.01	0.15
Cs-137	5 E + 4	2.5	-	66.48
Eu-152	5 E + 5	25	25.12	-
Eu-154	5 E + 5	25	1.89	-
Fe-55	5 E + 5	25	7.23	3.65
Ni-63	5 E + 5	25	2.71	25.33
H-3	5 E + 6	250	58.74	-
Sr-90	5 E + 4	2.5	-	1.30
Y-90	5 E + 5	25	-	1.30

SUMMARY

With the release of the Radiation Protection Ordinance the release criteria has changed completely. Formerly the clearance values were part of the licenses, now the same clearance levels are defined the Radiation Protection Ordinance and are applicable to all nuclear sites in Germany. Depending on the existing nuclide distribution, the clearance values are higher than before in some cases and more restrictive than before in other cases. The new release criteria can be ensured and quantified by measurements, and the release is still practicable.

REFERENCES

[1] German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Bonn): Verordnung über den Schutz vor Schäden durch ionisierende Strahlen (Strahlen-

schutzverordnung – StrlSchV) – (*Radiation Protection Ordinance*), Bundesgesetzblatt Teil 1, p. 1714, Bonn, July 20, 2001

[2] Council of the European Communities: Council Directive 96/29/Euratom laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, Official Journal of the European Communities, ISSN 0378-6978, L 159, Vol. 39, 29.06.96

[3] Modeling for the Derivation of Levels for the Release of Buildings and Sites
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17. June 2002, Research Centre Karlsruhe
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