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**Radiological protection principles concerning the use for  
forest and agricultural purposes and as  
public gardens (parks) and residential areas  
of areas contaminated by uranium mining**

Recommendation of the German Commission on Radiological Protection

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Adopted at the 105<sup>th</sup> session of the Commission on Radiological Protection  
on October 7/8, 1991

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of the series "Publications by the Commission on Radiological Protection"  
under the title:

**Strahlenschutzgrundsätze für die Nutzung  
von durch den Uranbergbau kontaminierten Flächen  
zu forst- und landwirtschaftlichen Zwecken sowie als Grünanlage  
(Parkanlage) und Wohngebiet**

Empfehlung der Strahlenschutzkommission

**In the event of any doubts about the meaning,  
the German original as published shall prevail.**

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# Table of Contents

- 1 Scope ..... 4**
- 2 General principles ..... 4**
- 3 Criteria for subsequent uses..... 5**
- 4 Areas already in use ..... 6**

## 1 Scope

- 1.1** The following recommendation refers to areas contaminated by uranium mining, including contaminations on plant sites, at ore loading points as well as along transport routes. It does neither refer to tailings ponds and mine dumps nor to areas where contaminations are due to chemical ore treatment.
- 1.2** This recommendation deals with the uses of these areas in forestry and agriculture, as public garden (park) and as residential area (as well as similar uses, e.g. schools, kindergartens, office buildings). The industrial use (use for commercial and industrial purposes) is subject of the Recommendation of the Commission on Radiological Protection dated 28.06.1991.

The recommendation is based upon considerations on radiological protection of the general public and workers.

## 2 General principles

As a result of uranium mining in Saxony and Thuringia, different environmental media have been contaminated with uranium and its daughter products. In this given situation, the radioactive contaminations and resulting exposures can only retrospectively be controlled, restricted and reduced subject to optimization.

For the assessment and evaluation of the individual radiation exposure a level for unrestricted use is recommended below which no restriction to use shall be made for reasons of radiological protection. Furthermore, levels are recommended for a range within which certain restrictions shall be provided for. Above this range the necessity of measures shall be reviewed or other possible uses considered, allowing for the site-specific conditions.

The levels for unrestricted use are orientated on an additional potential radiation exposure of 1 mSv/a (effective dose) due to uranium mining activities. This value is within the variation of natural radiation exposure. For the individual environmental media, too, the recommended levels for unrestricted use are within the range of values known from the surveys on natural radiation exposure. Radon exposure indoors is not accounted for in the present context, as it is subject of the Recommendation of the Commission on Radiological Protection of June 30, 1988.

With regard to uses of contaminated areas for forest and agricultural purposes as well as for uses as public gardens (parks) and residential areas, all relevant exposure pathways have to be evaluated, i.e.:

- external radiation exposure to gamma radiation from the contaminated areas,
- radiation exposure by inhalation of radon daughter products outdoors,
- radiation exposure by inhalation of dust contaminated with long-lived alpha emitters outdoors,

- radiation exposure of children playing outdoors by ingestion of dust and soil contaminated with long-lived alpha emitters,
- radiation exposure by consumption of agricultural or horticultural products and
- radiation exposure by consumption of game and wild plants.

Additionally the radiation exposure of the general public due to potential ground water contamination has to be considered.

Assuming conditions as realistic as possible but sufficiently conservative, the dose estimates reveal that the external gamma dose rate and the potential activity input into the ground water are exposure pathways of relevance for all uses of contaminated areas considered here. Additional specific exposures pathways of relevance in cases of uses as residential areas and as public gardens are the ingestion of dust and soil contaminated with long-lived alpha emitters by children playing outdoors as well as the consumption of local products in cases of agricultural uses.

### 3 Criteria for subsequent uses

The decisive factor for the radiation exposure resulting from contaminated areas is the activity content of the U-238 decay chain within the contaminated soil, whereby the radioactive equilibrium is generally assumed. If there is no equilibrium, the radionuclide with the highest specific activity in the soil has to be considered. The specific activity of the relevant radionuclide of the decay chain (i.a. Ra-226) is expressed in terms of Bq per gram dry matter of the soil. When assessing the activity it is permitted to average over an area of 100 m<sup>2</sup>, at depths of

0.0 - 0.1 m

0.1 - 0.5 m

from 0.5 m down to the soils not contaminated by mining activities in steps of 1 m.

The following recommendations are therefore made for the different uses of contaminated areas:

- 3.1** If the mean specific activity in any of these layers is below 0.2 Bq/g, the area can be used unrestrictedly.
- 3.2** If the mean specific activity in any of these layers is below 1 Bq/g but within the range of 0.2 to 1 Bq/g, the area may be used unrestrictedly for forestry and as grassland for agriculture.

The area may be used as a park subject to the following reservations:

- Coverage of the soil in order to limit the local dose rate to a maximum of 0.3 µSv/h.
- If sports grounds, playgrounds and other recreation centres are established in parks, this is only possible on partial areas with a specific activity below 0.2 Bq/g.

In case of the use of several contaminated sites within the feeding area of one ground water horizon, an annual dose of 0.5 mSv should not be exceeded, if the ground water downstream of the sites is continuously used as drinking water.

- 3.3** If a specific activity of 1 Bq/g is exceeded in one of these layers, the necessity of taking measures should be reviewed, taking into account the site-specific conditions.
- 3.4** All new buildings on released sites have to be planned in a way that ensures by appropriate construction that the expected Rn-concentration does not exceed 250 Bq/m<sup>3</sup>.

## **4 Areas already in use**

In cases of areas that have already been built up or used for other purposes subsequent to uranium mining, decisions on the further proceeding shall be made on the basis of site-specific studies on radiation exposure.