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**Radiological protection principles  
concerning the release for industrial use  
of areas contaminated by uranium mining**

Recommendation of the German Commission on Radiological Protection

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Adopted at the 104<sup>th</sup> session of the Commission on Radiological Protection  
on June 27/28, 1991

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**Strahlenschutzgrundsätze bei der Freigabe von durch den Uranbergbau kontaminierten Flächen zur industriellen Nutzung**

Empfehlung der Strahlenschutzkommission

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

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## 1 Scope

- 1.1** The following recommendation refers to areas contaminated by uranium mining, including contaminations of plant sites, at ore loading points, as well as along transport routes. Tailings ponds and mine dumps, as well as areas contaminated as a result of chemical ore treatment, are explicitly excluded from the scope of this recommendation.
- 1.2** The recommendation deals with the release for uses as industrial sites, including the possibility of building factory-owned apartments, recreation centres, kindergartens and other facilities on the site. Any agricultural and forestry uses, however, are excluded from consideration.

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 levels for unrestricted use are recommended below which an unrestricted release is possible for reasons of radiation protection. Furthermore, levels for restricted use are recommended for a range within which certain preconditions for release have to be fulfilled. Above this range, appropriate remedial measures have to be set out within the scope of an optimization procedure, considering the site-specific conditions, whereby several options have to be studied at any time.

The levels for unrestricted use are orientated on an additional potential radiation exposure of 1 mSv/a due to uranium mining activities. This value is in the upper range of the variation of external exposure to natural sources of radiation. 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, as it is subject of the Recommendation of the Commission on Radiological Protection of June 30, 1988.

With regard to uses of contaminated grounds as industrial sites, generally all exposure pathways relevant during stays outdoors have to be evaluated, i.e.:

- external exposure to gamma-radiation from the contaminated areas
- radiation exposure by inhalation of Rn-decay products
- radiation exposure by inhalation of dust contaminated with long-lived alpha-emitters
- direct ingestion of dust and soil contaminated with long-lived alpha-emitters by children playing outdoors.

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 radiation exposure from inhalation of both contaminated dust particles and Rn-decay products is lower by almost one order of magnitude than external radiation exposure. The gamma dose rate above the contaminated areas and the potential input of radioactivity into the ground water therefore are relevant exposure pathways during the use of contaminated grounds as mere industrial sites.

If factory-owned apartments, recreation centres, kindergartens or other facilities on the grounds are considered additionally, then the exposure pathway of direct ingestion of soil or dust by playing children is of relevance, too.

### 3 Criteria for release

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 generally is assumed. If there is no equilibrium, the radionuclide with the highest specific activity in the soil has to be considered. The activity content  $A$  is expressed in terms of specific activity of the relevant radionuclide of the decay chain (generally Ra-226) in Becquerel per gram dry matter of the soil. When assessing the activity it is permitted to average over an area of  $100 \text{ m}^2$ , at depths of:

0.0 - 0.1 m

0.1 - 0.6 m

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

The following recommendations are made with regard to releases of contaminated areas for uses as industrial sites:

- 3.1 With an activity  $A$  below  $0.2 \text{ Bq/g}$ , the ground can be released unrestrictedly.
- 3.2 With an activity  $A$  below  $1 \text{ Bq/g}$ , the ground can be released for use as industrial site, subject to the following reservations:
  - construction and use of factory-owned apartments, recreation centres and kindergartens are only permitted on partial areas with an activity below  $0.2 \text{ Bq/g}$ .
  - If necessary, the soil must be covered, in order to reduce the local dose rate to  $0.3 \mu\text{Sv/h}$ .

Additionally, in case of the release of several contaminated sites within the feeding area of one ground water horizon, the competent authority has to check whether an annual dose of  $0.5 \text{ mSv/a}$  is not exceeded if the ground water downstream of the sites is continuously used as drinking water.

- 3.3 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  $250 \text{ Bq/m}^3$ .