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Principles tor the assessment of radiation exposure as a result of radon emissions from mining residues in the uranium mining areas of Saxony and Thuringia

Recommendation of the German Commission on Radiological Protection

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Grundsätze zur Bewertung der Strahlenexposition infolge von Radon-Emissionen aus bergbaulichen Hinterlassenschaften in den Uranerzbergbaugebieten Sachsens und Thüringens

in the Bundesanzeiger No. 158 of 23 August, 1995.

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

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1 Problems

In 1991, the Commission on Radiological Protection (SSK) gave several recommendations [SSK 92] regarding radiological protection problems with typical intervention situations such as the use and release of areas, mine dumps and buildings which have been contaminated by uranium mining. These recommendations did not include, for instance, mine dumps with increased amounts of pyrites, leached low-grade ore dumps, tailings dumps from metallurgical and chemical processes and tailing ponds. Regarding dumps with a specific Ra-226 activity > 0.2 Bq/g, the recommendations of the Commission on Radiological Protection were limited to small dumps, i.e. covering an area < 1 hectare or a deposed material quantity of < 10^5 m^3. Additionally, with specific activities of > 1 Bq/g and already existing use, investigations were recommended in accordance with the specific conditions at the location.

During examination of all possibly relevant exposure pathways the conclusion was reached that, for those objects which were included in the 1991 recommendations, an exposure by inhalation of radon decay products in open air does not belong to the relevant exposure pathways for all consecutive utilisations taken into consideration. Regarding the exposure through radon decay products in buildings a special SSK recommendation of 1988 was referred to.

For objects covering a large area or in cases where the restrictions of the until now existing recommendations concerning the type and the contamination of the object are exceeded, it cannot be excluded that radon emissions from these objects lead to exposures which are no longer irrelevant. It must also be taken into consideration that the radon emission from mining residues does not only occur in the open air but contributes too to an increase of already existing radon contents in buildings if they are located near to these objects. This influence on the indoor air concentration possibly leads, due to the fact that people remain indoor for longer periods of time, to a considerable exposure to radon from mining residues and demands, regarding radiological assessment, the same treatment as the exposure to other radon or radon decay product concentrations in buildings from geogenic or technogenic sources.

In 1994 the SSK passed a recommendation [SSK 94] regarding exposure through radon decay products in buildings which included a further development of former recommendations and was orientated on new findings and recommendations. Because dosimetric lung models for radon and its decay products are not secured as yet, the SSK did not base its recommendation regarding the limitation of radiological exposure in buildings on dose values but on the normal variation range (so-called “normal range“) of the radon concentration in which reduction measures of this concentration are regarded as necessary, independent of their causes. The upper end of this normal range of radon concentrations in buildings of the Federal Republic of Germany is a value of 250 Bq/m^3.

2 Level of outdoor radon concentration for the assessment of mining influences

The assessment of outdoor radon concentrations must be based on the same basic principle i. e. the orientation on the normal variation range. This is in accordance with the recommendation of the SSK regarding the assessment of radon exposure in houses as well as with the radon recommendation of the ICRP [ICRP 93].

To enable a measurement of the normal variation range of outdoor radon concentrations one must refer to measurements which have been carried out in a similar geological region as the mining area but in which the influence of mining on the outdoor radon concentration can be disregarded. Extensive measurement revealed that the upper end of the normal range amounts to a value of 80 Bq/m^3.

The SSK therefore recommends a level for the long-term outdoor radon concentration in residential areas, possible future residential areas and other areas where people stay permanently near mining residues, of 80 Bq/m^3. Due to spreading conditions, the radon concentration is usually lower outdoors than in buildings. The level for outdoor radon concentrations is therefore lower than the upper limit of the normal range in buildings (250 Bq/m^3). Both values are orientated on the upper limit of the natural variation range.

If the long-term average values of outdoor radon concentrations in residential areas or possible development areas are below this level, restoration of the mining residues is not regarded as justified as far as a reduction of the radon emissions is concerned. If this level is exceeded for a long period of time in the above areas one must investigate whether the increase is caused by the mining residues.

3 Level of outdoor radon concentration for the consideration of remedial measures

If an investigation in accordance with no. 2 reveals that the share of outdoor radon concentration caused by mining residues exceeds 50 Bq/m^3, the need for remedial measures must be taken into consideration.

The recommendation of the SSK given in this paper means that an assessment of radiological exposure through residues from uranium mining, in which the specification of essential interventions is in the foreground, should separate the exposure to radon and its decay products by inhalation from all other exposure pathways. This exposure must not be included into the exposure calculation for the comparison with the dose level of 1 mSv/a for the sum of contributions of other exposure pathways but be limited by separate levels. On the one hand, the difficulty in converting activity concentrations into dose values is taken into account [3] and, on the other hand, the principle is expressed to orientate the levels for measures and interventions, which are needed for residues from uranium mining, directly on the natural variation of radon concentrations.

4 References

[SSK 92] Strahlenschutzkommission: Strahlenschutzgrundsätze für die Verwahrung, Nutzung oder Freigabe von kontaminierten Materialien, Gebäuden, Flächen oder Halden aus dem Uranerzbergbau. Empfehlungen der Strahlenschutzkommission mit Erläuterungen. Veröffentlichungen der Strahlenschutzkommission, Band 23, Stuttgart: Gustav Fischer Verlag, 1992

[SSK 94] Strahlenschutzkommission: Strahlenschutzgrundsätze zur Begrenzung der Strahlenexposition durch Radon und seine Zerfallsprodukte in Gebäuden. Empfehlung der Strahlenschutzkommission, verabschiedet auf der 124. Sitzung der Strahlenschutzkommission am 21. April 1994, Bundesanzeiger Nr. 155, 18.08.1994

[ICRP 93] International Commission on Radiological Protection: Protection against radon-220 at home and at work. ICRP-Publication 65, Annals ofthe ICRP, Vol. 23, No. 2, 1993