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Investigations on the biological effects of radon in residential houses

Radon is a natural radioactive noble gas occurring overall in the environment. Due to its mobility and its relatively long half-life of 3.82 days the gas enters the atmosphere as well as buildings and homes over leakages in subsoil and foundations. There it can enrich in high concentrations according to constructional and building material conditions and according to the ventilation behaviour of the population. In Germany, the median value of radon concentrations in dwellings is about 50 Bq/m³. Depending on the geological conditions and also due to mining relics there are residential houses with radon concentrations of more than 10,000 Bq/m³ in some areas of Germany (in particular Eastern Bavaria, Saxony, and Thuringia). For the total population exposure to indoor radon is the main exposure due to natural radioactivity.

It was the objective of a study carried out by the Federal Office for Radiation Protection (BfS) and supported by the Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen to determine to what extent biological effects could be detected in inhabitants of buildings with enhanced radon concentrations. As a biological indicator for radon exposure chromosome changes in peripheral blood cells (lymphocytes) were used.

Four different exposure groups from Bavaria and Saxony with varying concentrations of radon in the dwellings were examined, and two different cytogenetic methods were applied.

As radon and its decay products mainly enter the body via the lung, the lymphocytes of the circulating blood are exposed, and a small part of the radon reaches the fat component of the red bone marrow as a result of its good fat solubility. Because of these two different ways of exposure, radiation exposure was examined directly in the peripheral blood with the help of the conventional fluorescence-plus-Giemsa (FPG)-dyeing, thus determining the frequency of the so-called dicentric chromosomes

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(dic) and centric (cr) rings. Besides, the frequency of the so-called translocations was determined with the help of the newer method of fluorescence-in-situ-hybridisation (FISH) technology. This frequency of translocations can be induced in both the peripheral blood and in the blood-forming tissue and can then also be detected in the peripheral blood.

The study shows a significant increase in the frequency of cells with chromosome changes (dic + cr) which are directly generated in the peripheral blood, for radon exposed persons altogether in comparison with a healthy control group. From exposure group II on (200 – 1000 Bq/m³, mean value 450 Bq/m³), more statistically significant chromosome changes were found than in the control group. With increasing radon concentration in the homes an increase in the frequency of chromosome changes can be observed, which does, however, not vary significantly between the individual exposure groups. An increase in translocations could be detected in persons older than 40 years in the highest exposed group. There were also indications that the predominant part of the translocations detected in the blood was induced in the blood-forming tissue.

The investigations show that following chronic exposure to high radon concentrations in residential buildings a biological effect in the peripheral blood of the inhabitants can be identified and that, therefore, one should aim at introducing a limit value to generally reduce radon concentration.

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Introduction of Mammography Screening in Germany

On 28 June 2002, the German Bundestag consented to the application "Breast cancer – more quality at early diagnosis, care and research – pro mammography screening according to European guidelines". In this application the Federal Government is required to work towards the introduction of an overall screening programme according to these guidelines by the common self-administration of physicians and health insurance companies from 2003 on.

The central associations of the compulsory health insurance companies and the Federal [Association of CHI Physicians](#) (KVB) followed this request and decided on 24.03.2003, on the occasion of the meeting of the federal association of physicians and health insurance companies, to amend the guidelines on the early diagnosis of tumour diseases (guidelines on the early diagnosis of cancer) with the aim to gradually introduce a mammography screening with a screening interval of two years for 50 to 69-year-old women, on the basis of the European guidelines. Until 2005, following an implementation phase, the screening programme

shall be offered all over Germany. In the drafts worked out by the partners of the federal general agreements for the amendment to the early diagnoses directives and the amendment to the federal general agreements, it is specified in which form the decision of the federal committee dated 24.03.2003 can be actually implemented in the medical care of CHI physicians. In December 2003, these drafts were decided by the federal committee.

In view of the authorisation of early diagnosis programmes with screening by the competent supreme state health authorities which is required according to the X-ray Ordinance, the above mentioned drafts were demonstrated and discussed in regular meetings between the partners of the federal general agreements and the Federal Ministries for Health and Social Affairs (BMGS) and for the Environment, Nature Conservation and Nuclear Safety (BMU). BfS was involved in this discussion and elaborated on the basis of the European guidelines a catalogue of minimum requirements on an early diagnosis programme for breast cancer, which again was the basis for the BMU evaluation of the submitted drafts. In this catalogue BfS demands that X-ray mammography within the scope of the early diagnosis of breast cancer should only be carried out in specialised installations, which implement the strict European criteria and are subjected in particular to the strict external controls regarding devices and diagnostic findings. In the opinion of BfS the guarantee of this high and reproducible quality level is an indispensable condition for the introduction of an early diagnosis by means of X-ray mammography all over the country. It must be the objective of all measures to offer the women in Germany an early diagnosis programme for breast cancer on the highest quality level possible. The passed version of the amendment to directives concerning the early diagnosis of cancer and the amendment to the federal general agreements reflect these demands.

Parallel to these activities the equivalence of the technical requirements on X-ray mammography systems according to the directives pursuant to the European guidelines, i. e. in particular with the European Protocol for the Quality Control (EPQC) was audited in a working group of the state committee "X-ray Ordinance" (LA-RöV). BfS was also represented in this advisory body. The audit referred in particular to the Quality Assurance Directive, the Expert Examination Directive as well as the DIN 6868-7 and 6868-2 standards. Discrepancies to the EPQC showed in a few but significant issues. From the BfS point of view, accreditation pursuant to § 25 RöV can only be justified if an equivalence of the corresponding directives with the EPQC is guaranteed. This demand by BfS was implemented to a large extent with the decision of the LA-RöV on the occasion of the meeting on 5th/6th November 2003 in Bonn. Thus,

from the BfS point of view, all technical conditions with regard to the quality of mammography screening have been created.

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Report on the 39th Berlin Colloquium from 23rd to 25th October 2003

The colloquium took again place this year in the Federal Office for Radiation Protection. Foreign participants came from Denmark, Finland, Latvia, Lithuania, Luxembourg, Norway, Sweden, Slovakia, Czech Republic, and Hungary. From Germany, representatives of BfS, BMU, and representatives of federal state authorities from Brandenburg and Berlin participated. The participants discussed in an open and easy way four current topics of radiation protection, each of which was introduced in a lecture by a BfS member.

The following topics were dealt with:

1. Risk communication for ionising and non-ionising radiation with media and the population (T. Jung and H. Jahraus)

At present, risk communication does in most cases not fulfil the need for appropriate, balanced, and judgement-supporting communication – which is demanded by the population, and rightly so without doubt. Therefore, within the scope of the Aktionsprogramm Umwelt und Gesundheit APUG (Action Programme Health and the Environment), a guideline for the development of a multi-stage procedure of risk communication was elaborated as a first step on behalf of BMU and BMGS. According to this guideline, risk communication can be subdivided into different steps:

- Communication between experts within an authority and between authorities
- Communication between experts of the authority and external scientists and experts
- Communication of authorities with so-called “stakeholders”
- Communication with the general public.

Risk communication in the process of regulatory decisions and within the scope of authority acting was then represented in different scenarios.

2. The tasks of BfS in the prevention against nuclear hazards (D. Mertens)

On request, BfS supports with expert knowledge and measurements the competent state authorities of the interior in serious cases of defence against nuclear hazards by carrying out the following tasks:

- Assessment of the radiological consequences in case of a detonation of an improvised explosive device with radioactive additive (dirty bomb)

- Support of the search for radioactive materials with the help of measurements
- Analysis of the radioactive material of a “dirty bomb”
- Technical support in the limitation of radiological consequences.

Practical demonstrations of defence against nuclear hazards took place on Friday afternoon at the Lehnin training area.

3. The principle of precaution in the case of non-ionising radiation (A. Dehos)

Both the World Health Organisation (WHO) and the European Commission clearly argue for the application of the principle of precaution in those cases where risks can be assumed due to exposure to a physical, chemical, or biological agents, but where no scientific findings are available for evaluating the risk clearly. Both institutions aim at defining the conditions for the application of the principle of precaution and determining criteria for reasonable precautionary measures.

Precautionary measures and recommendations are also supported for the area of UV radiation by the WHO and the European Commission.

In the lecture the “Precautionary Framework for Public Health Protection” of the WHO was introduced and the legal provisions explaining in more detail the precautionary measures and recommendations for the two areas of non-ionising radiation – EMF and UV radiation – in the Federal Republic of Germany.

4. Regulations to guarantee radiation protection for members of the public when using and removing NORM residues (E. Ettenhuber and K. Gehrcke)

The Directive 96/29 EURATOM demands by the EU member countries that

- By means of appropriate investigations or other appropriate means the work should be determined, at the performance of which residues are produced that can significantly increase the exposures of single members of the public and of workers
- Provisions for monitoring radiation exposures should be taken, and, if required
- Remedial measures according to Title IX or parts thereof (Article 41 letter a) and radiation protection measures according to Titles III, VI, and VIII or parts thereof are carried out.

In the lecture the concept for guaranteeing radiation protection of the population in the case of residues, work, and the regulations made for this in the Radiation Protection Ordinance was summarised.

The foreign and German participants in the colloquium got numerous suggestions for their further work from this exchange of opinions and experience. Therefore, all participants expressively

wished to continue the Berlin Colloquium in the existing frame. The informal international exchange of experience is of extreme benefit for the participants.

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Transboundary Environmental Impact Assessment for Southern German Interim Storage Facilities

The Republic of Austria was involved in the transboundary environmental impact assessments (EIA) within the scope of the licensing procedures for the interim storage facilities at the Biblis, Grafenrheinfeld, Gundremmingen, Isar, Neckarwestheim, and Philippsburg sites. In November 2001 it applied for its involvement on the basis of the European EIA directive and the Espoo Convention, since from its point of view considerable environmental impacts of the projects on the Austrian national territory could not be excluded, in particular in case of accidents. The other neighbouring countries dispensed with such an involvement.

For the Republic of Austria the application documents were laid open to public inspection separately in Austria and a special public hearing took place in Munich. Austrian citizens submitted about 60,000 objections against the six projects. Already about 180,000 objections had been raised in the course of involving the public in Germany. In the public hearing, questions concerning deliberately caused air crashes, safety of containers, possible releases, and the possibility of considerable impacts on the Republic of Austria were discussed.

BfS and the Republic of Austria regularly carried out consultations in which also the state governments of the federal states of Oberösterreich, Salzburg, Tirol, and Vorarlberg participated.

Within the scope of the licensing procedures for on-site interim storage facilities the Federal Republic of Germany for the first time performed and successfully concluded transboundary environmental impact assessments for nuclear facilities located in Germany. The Republic of Austria submitted final statements on all Southern German on-site interim storage facilities. No concerns with regard to transboundary impacts are expressed in these statements. The Republic of Austria expressed the request, however, to contribute to minimising the residual risk of considerable environmental impacts on Austrian national territory by erecting and operating the projects according to application and by continuously controlling and re-evaluating safety regarding new developments (e. g. new types of airplanes).

The very good and open co-operation with the Austrian EIA experts, federal experts and state representatives has to be emphasised. The proceeding in the execution of the procedures is to serve the Republic of Austria as a basis for the perfor-

mance of transboundary environmental impact assessments for interim storage facilities in the Czech Republic (Temelin transport container storage facility) and in Switzerland (Gösgen wet storage facility).

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BfS representative chairs the "Nuclear Safety and Radiation Protection" working group of the Baltic Council

The Baltic Council was founded in Copenhagen in 1992. The countries bordering the Baltic Sea including Norway and Iceland belong to it. The EU Commission is equally represented in the Council. It is the objective of the Council to support the political, economic, and cultural co-operation in the Baltic. For this, among others, four permanent working groups were established dealing with the following topics:

- Economic co-operation
- Support of democratic institutions
- Protection of children at risk
- Nuclear safety and radiation protection.

BfS has taken over chairmanship of the last mentioned working groups for the next 3 years. It is the task of the working group to improve the exchange of information and the co-operation in the field of nuclear safety and radiation protection of man. Currently the working group deals with the following problems: origin and handling of illicit radioactive sources in the Baltic, use of radioactive sources with high radionuclide inventory in civilian areas (e. g. Sr-90 batteries) and assessment of the potential dangers for the population associated with this, and mutual assistance in case of nuclear accidents. This working group is an important body for the transboundary improvement and harmonisation of radiation protection in the Baltic and has already made first suggestions. It offers to establish a centre for the exchange of environmental measuring data from all countries bordering the Baltic Sea at BfS Freiburg. Thus, all participating countries could simultaneously and very rapidly access current measurement results from the whole Baltic. This would considerably improve the conditions for a common evaluation of a radiological situation and the discussion of measures for the protection of man. Other proposals concern the harmonisation of radioactivity measurements and environmental measuring programmes.

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