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Are High Frequency Electromagnetic Fields able to raise the risk of cancer?
Report on the international workshop "Are RF-fields able to raise the risk of cancer" of November 15 - 17, 2004 in Schriesheim, Germany

In view of the increasing use and propagation of high frequency electromagnetic fields, in particular in the area of mobile communications, the issue of possible negative effects on people's health is a common subject of public discussion. Apart from possible effects of these fields on sleeping patterns, the general well-being and cognitive skills, the issue is raised whether high frequency electromagnetic fields (HF-EMF) are able to raise the risk of cancer.

The Research Association for Radio Applications (Forschungsgemeinschaft Funk), COST 281, EMF-Net and the Ministry of the Environment and Transport of Baden-Württemberg have held a workshop on this subject. The comprehensive scientific data available by now were presented with respect to the question if high frequency electromagnetic fields, in particular fields in mobile communications, are able to directly cause cancer or to promote the development of cancer. The focus was laid on discussing new epidemiological results, particularly those of the INTERPHONE studies and long-term studies in laboratory rodents.
The opinion prevailed that HF signals which do not reach intensities where thermal effects occur are unable to trigger detrimental effects on genes or cells. Although a certain influence on gene expression, i.e. on the transfer of genetic information into functioning gene products in the cells, could not be excluded, it was considered highly questionable that this is relevant for the living organism.

The results from the European research programme REFLEX, where cell cultures were used exclusively, had not been taken into account in the survey lecture due to the missing scientific publication of data for the high frequency area. Yet it was discussed how genotoxic effects as described in the REFLEX project should be

interpreted, if they cannot be discerned in the living organism. This question remained open.

Dr. Lerchl (IU Bremen) fundamentally portrayed the same results in his lecture, which concentrated on experimental studies on animals. However, he pointed out the necessity to challenge studies with a negative result (no effects detectable) as carefully as studies with a positive result (effects detectable). Studies without statistical power analyses, for example, where the number of animals examined was too low, should clearly be indicated as having "no explanatory power". Dr. Lerchl further presented the hitherto existing results of his study performed in the framework of the German Mobile Telecommunication Research Programme (Deutsches Mobilfunk Forschungsprogramm, DMF) on the influence of chronic exposure to GSM signals on so-called AKR mice. This mouse strain is highly susceptible to lymphoma, i.e. especially to this form of cancer of the blood producing system. The study presented by Dr. Lerchl does not indicate an influence of chronic field exposure according to GSM or UMTS standard on lymphoma development. The comprehensive histological analyses, however, are not yet completed.

Repacholi et al. observed in 1997 a higher lymphoma rate after HF exposure in genetically modified animals. This study attracted great attention and prompted a number of scientists to try and check these results and possibly verify them. As yet this has not been successful. The study presented by Dr. Lerchl does not support the observations of Repacholi either. Preliminary results of another study performed in Italy (Marino et al.) were presented as well. These scientists worked with the same animal model used by Repacholi, but it appears that such observations cannot even be confirmed here. A scientific publication of the data remains to be expected.

Particularly significant was the presentation of the first results of the extensive INTERPHONE project initiated in 1999, where the risks for the occurrence of brain tumours with the users of mobile communications was explored. It appears up to now that the general risk for brain tumours is not elevated even for long-term users of mobile phones. The Swedish study, however, shows an elevated risk for persons who have used mobile phones for more than 10 years to develop a benign tumour of the acoustic nerve, an acoustic neuroma (Lönn et al., 2004). It seems that a connection can be made with the use of the early analogue devices. Yet this does not mean that an increasing risk for the long-term use of digital devices can be excluded. At the beginning of the time span studied analogue phones were the only devices available on the market, which were employed by the long-term users and were then – within different intervals depending on the individual – replaced by the digital devices that came into use. A sufficiently large group of long-term users of digital devices only is not yet available.
The head researcher of the Swedish study, Dr. Maria Feychting, explained that the results should not be interpreted before the data from the other states participating in the INTERPHONE study, which partly examine a larger number of cases, was available.
It can be summarised that the majority of the participants does not find positive evidence for genotoxic effects of HF-EMF in the living organism in the existing scientific literature. Positive evidence for apoptosis (programmed cell death subsequent to serious damage to the cell) or necrosis (death of cells or living tissue) in the living organism could not be found either. The hypothesis that HF-EMF are carcinogenic cannot be supported as yet. The existence of possible tumour-promoting effects remains an unsolved problem.

The workshop offered a broad overview of the current scientific data on the subject of HF-EMF and cancer. Yet it is not possible to comment on the question "cancer due to HF-EMF – yes or no?" since the existing data is not sufficient. It is expected that the numerous studies that are currently being carried out on this issue will reduce the number of existing uncertainties.

Monika Asmuß
Department Radiation Protection and Health

Network for biological dosimetry

After a large scale radiation accident or a terrorist attack with a great number of potentially irradiated people medical care of the contaminated victims starts with the "triage" (classification of the radiation accident victims according to their exposure rate level). Initially, clinical symptoms in the victims have priority over dosimetric aspects. Yet it is necessary to gain exact information on level and type of the exposure in the course of medical treatment so that a sensible treatment based on a largely substantiated determination of the exposure can be developed. Reliable information on the dose received is also necessary for estimating the cancer risk associated with the exposure rate. To this end, biological dosimetry is, in addition to physical dosimetry, the method of choice in order to substantiate the estimation of the dose received for each individual.

In order to ensure that biological dosimetry can still be performed on a great number of people after a radiation accident it is necessary to network expert biological dosimetry laboratories so that they can, in the event of an accident, jointly analyse the blood samples for radiation-induced cytogenetic damage. Most individual laboratories are too small to perform such an analysis due to limited resources. For this reason, a network for biological dosimetry was established linking the National Radiation Protection Board (NRPB, UK), the Institut de Radioprotection et Sûreté Nucléaire (IRSN, France) and the Bundesamt für Strahlenschutz (BfS, Germany) in order to increase total capacity and to be able to react flexibly on events. Other European states are interested in joining the network.

Biological dose estimation is performed on the basis of two established methods, i.e. analysis of dicentric chromosomes and analysis of micronuclei. The analysis of dicentric chromosomes is the preferred method since the formation of dicentric chromosomes is characteristic for the occurrence of ionising radiation and makes it possible to distinguish whole body exposure from partial exposure. If a great number of people needs to be examined in the event of an accident the analysis of micronuclei can be used as well.
The laboratory situated in the country where an event with radiological impact on a great number of people has occurred takes the lead within the network. The

same laboratory will decide if and to what extent the network needs to be activated. All results will be delivered to this laboratory and combined. This laboratory also is the contact for the medical institutions treating the accident victims.

Ursula Oestreicher
Department Radiation Protection and Health

Report on the 40th Berlin Colloquium of October 21 – 23, 2004

The colloquium jointly prepared by the Departments SW and SG of BfS took place once again on the premises of the Federal Office for Radiation Protection (BfS) in Berlin. International participants from eleven European countries, by now all member states of the European Union, attended the Colloquium as well as a representative of the European Commission. The only German representatives present, apart from BfS speakers, were representatives of the Land of Berlin.

The participants discussed four current subjects of radiation protection as freely and openly as it is typical of this Colloquium, each subject being introduced with a summary lecture held by BfS staff.

The following subjects were discussed in detail:

1. Frequency and dose rate of x-ray diagnostic and nuclear medical examinations (Ms E. Nekolla)

Since the early 1990s BfS collects and analyses data on the medical exposure to radiation in Germany. The analysis presented is based on data from the years 1996 to 2001. With this analysis a new concept was implemented, which makes it possible to analyse trends over a period of several consecutive years and improves the alignment with international standards.
Germany ranks high on the international scale with regard to the frequency of x-ray diagnostic procedures, featuring 1.8 examinations per year and inhabitant, a figure which has remained relatively constant over the years. The average effective dose per inhabitant, however, has increased from approx. 1.6 mSv in 1996 to approx. 1.8 mSv in 2001. This increase results mainly from the augmented application of computer tomography.
In the field of nuclear medical diagnostics an average of 3.8 million radionuclide applications per year (47 examinations per 1,000 inhabitants) were registered. This means an average effective dose of 0.13 mSv per inhabitant and year and is a rather low value compared to the exposure in x-ray diagnostics.

2. Diagnostic reference levels – Implementation in Germany (Mr J. Griebel)

According to the ICRP recommendations and the requirements of the Directive 9743/EURATOM, BfS establishes and publishes diagnostic reference levels (DRL) since 2003.
The physicians' and dentists' associations, who are responsible for quality assurance, are required to verify compliance with the DRL and to recommend, if necessary, measures to reduce the radiation exposure. To this end, they compare the dose rates of the patients as determined by the operators of the equipment or the applied activities with the DRL and spot check whether the image quality satisfies medical needs. Operators who exceed the DRL without due cause have to modify their procedures or equipment in such a way that they comply with the DRL.
BfS establishes and updates the DRL in regular intervals on the basis of this data. It is expected that the medical radiation exposure of the population can thereby be reduced in the long term. The participants discussed at great length issues regarding the status of the implementation and monitoring of the DRL in Germany as well as definitions of possible permanent and not justified higher diagnostic doses in other countries.

3. Radiation protection aspects in the disposal of radioactive wastes (Mr. V. Kunze)

BfS is charged with licensing interim storage facilities for spent nuclear fuel and with the erection and operation of installations for the disposal of radioactive wastes.
The radiation protection-related requirements for these installations are derived among others from the Radiation Protection Ordinance, the Guideline on the Monitoring of Emissions and Immissions and the guidelines issued by the Reactor Safety Commission (Reaktor-Sicherheitskommission, RSK). Several examples were cited in order to illustrate the implementation of these requirements. With regard to the licences recently granted by BfS for interim storage facilities for spent fuel elements at the sites of nuclear power plants, specific mention was made of the determination of radiation protection areas, potential interaction with plants in the vicinity and the procedure used to determine the potential radiation exposure of the population. In addition, the ventilation concept for repositories was explained. The lecture was concluded with a statement of the occupational radiation exposure occurring in the field of waste disposal.

4. Status of the incorporation of the EU Drinking Water Directive into national law (Mr. D. Obrikat and Mr. T. Bünger)

The activity concentration of natural radionuclides, contained in drinking and mineral water, from the uranium and thorium decay chains varies largely. Even the radionuclide composition differs considerably, depending on the local hydrological situation and the different concentrations of uranium and thorium in the bedrock. Elevated radioactivity values are often found in waters from areas with a predominance of granite.
In the context of a representative BfS study performed in 2000 and 2001, the activity concentrations of dose-relevant natural radionuclides was determined for a great number of commercially obtainable mineral waters. The results are available on the internet on the BfS website. BfS presently conducts similar national analyses of drinking water. So far the results show that the radiation exposure from the consumption of drinking water is relatively low.
However, the WHO's reference level of dose of 0.1 mSv/year for babies and infants might be exceeded when consuming waters from elevated natural radioactivity areas. In this context the participants discussed the legal regulations of the individual EU member states and the associated surveillance strategies.
Complementary to this meeting, the participants took an impressive guided tour through the Friedrichshagen waterworks on Friday afternoon, followed by a visit of the adjoining waterworks museum.

The colloquium allowed its national and international participants to share ideas and experience and to be inspired for their further projects. Such a free international exchange of experience is very fruitful for all researchers who participate in the colloquium. As usual on the last day, potential topics for discussion at the next Berlin Colloquium were elaborated.

Andreas Dalheimer
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Gerald Kirchner
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Certification completed for RASA monitoring capability of Schauinsland, required to monitor the Nuclear-Test-Ban Treaty

Compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) is monitored by the corresponding organisation CTBTO with the help of a special monitoring system. The terms of the treaty specify 321 monitoring capabilities all over the world. 80 facilities are used for monitoring radioactivity in the atmosphere. In addition to that, there are 170 seismic facilities, 11 facilities for measuring sound waves in the oceans, and 60 facilities for registering infrasound in the atmosphere. The International Monitoring System (IMS) must be fully operative when the treaty enters into force. It will then be able to detect, identify and locate a nuclear explosion of one kiloton TNT equivalent or more at any place on earth with high probability. The IMS is currently being set up.

All radioactivity measuring capabilities of the IMS are equipped with high volume dust samplers that collect particles from approx. 24,000 cubic meters of air in daily samples and perform gammaspectrometric measurements on them. The detection limit for the reference nuclide barium-140 is below 10 $\mu Bq/m^3$. At the BfS monitoring capability of Schauinsland the automatic system "RASA", developed in the U.S.A., is in operation. The system has been running since July 2003 without any noteworthy interruptions. In November 2004 technical modifications were carried out that were required for certification.

Before the certification process was completed on December 22, 2004 experts verified in a one-week visit to the facility whether the air samples taken at Schauinsland and their analysis comply with the strict CTBTO regulations and whether all work processes follow the accurately documented procedures set out in the station's operational manual. This is the only way to ensure that, if a suspicion arises, the monitoring system can deliver data which cannot be doubted and will count as valid evidence when a decision on sanctions due to a breach of contract needs to be taken. The filter samples will then be of special importance and will be sent to certified laboratories for further analysis as pieces of evidence.

BfS is now committed to ensure uninterrupted operation of the facility as required by the station's operational manual, to guarantee certainty and reliability of the measurements, and to repair faults immediately.

The contract further stipulates that radioactive xenon is supposed to be measured at 40 radionuclide measuring stations, among others at the BfS facility of Schauinsland. This noble gas is usually also released in underground explosions. The detection of xenon will complete the monitoring activities. The required measurement technique is still being developed but has reached an advanced level of development. BfS had already conducted a comprehensive comparison experiment in Freiburg and has been operating a system developed by the French nuclear energy commission at Schauinsland since February 2004. Adequate certification requirements for noble gas measurement techniques are currently elaborated in intensive international cooperation, which benefits from the long-term experience of the noble gas laboratory in Freiburg.

Apart from monitoring compliance with the treaty itself, this measuring system has a high potential for civil and scientific usage. BfS and German experts from other fields of study have promoted for quite some time the release of the IMS for further usage. Such an international monitoring system for radioactivity in the atmosphere is unique and can be used for the protection of the population from large-scale contamination. The filter samples, which are all taken according to uniform standards, offer a high potential for the study of trace elements in the air. The data from the seismic system can be used, for example, for warning the population of tsunamis. Due to the flooding in Southeast Asia this is a current and urgent subject, which forces the parties to the treaty to reconsider their current restrictive information policy.

Matthias Zähringer
Department Radiation Protection and Health

New Head of the Department Safety and Nuclear Waste Management

Since December 15, 2004 Dr. Ulrich Kleemann is the new head of the Department Safety and Nuclear Waste Management at the Federal Office for Radiation Protection (BfS) in Salzgitter.

After his studies of geology in Bochum, Dr. Kleemann worked for the German Continental Deep Drilling Programme and earned his doctorate in the framework of this programme. Afterwards, Dr. Kleemann was employed as scientific expert by a consulting company and was significantly involved in searching for sites for waste management plants (e.g. hazardous waste sites). In the following ten years he held the position of head of department for waste management, environmental protection, public health and veterinary medicine of a county administration in Rhineland-Palatinate.

The BfS Department Safety and Nuclear Waste Management is responsible for issues relating to the disposal of radioactive wastes, licensing procedures for interim storage facilities and transports of nuclear fuels and radioactive material with a high level of activity as well as Government custody. Its field of activity comprises, among others, the erection, operation and decommissioning of federal installations for the long-term storage and disposal of radioactive wastes. This includes the decommissioning procedure of the Morsleben repository and the search for and selection of a site for a repository for all types of radioactive wastes in Germany.

Henning Rösel
Vice-president