

# **RADIATION MONITORING NETWORK OF THE CZECH REPUBLIC**

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## **Introduction**

The Radiation Monitoring Network (RMN) of the Czech Republic (10 300 000 citizens, 78 900 km<sup>2</sup>) was established after the Chernobyl accident in 1986 and it is developed all the time. It is co-ordinated by the State Office for Nuclear Safety (SONS, [www.sujb.cz](http://www.sujb.cz)) in co-operation with the National Radiation Protection Institute (NRPI, [www.suro.cz](http://www.suro.cz)). At present time a legal basis for RMN is given by the “Atomic Act” No. 18/1997 Coll. and especially by the Regulation of the SONS No. 319/2002 Coll.

RMN performs in two modes of operation: the normal mode, aimed at monitoring of actual radiation situation (including the consequences of previous emergencies such as the Chernobyl accident) and at early detection of radiation accidents, and the emergency mode, aimed at evaluation of consequences of such radiation accident. The normal mode of operation is represented by continuous operation of permanent parts of RMN, in the emergency mode additional parts of RMN are engaged.

Czech RMN consists of the several subnetworks, which include selected or all permanent parts of RMN. The subnetworks are following: the Early Warning Network (EWN), the TLD Territorial Network, the Network of the Measuring Sites of Air Contamination, the Network of Laboratories Equipped with Gamma-spectrometric and Radiochemical Analytical Instrumentation, the Ground and Airborne Mobile Groups. The Laboratory of Monitoring of Internal Contamination and the information system (IS) are a significant part of RMN, too.

## **Early Warning Network of the Czech Republic**

The EWN has been established after 1990 to provide overview information about a radiation situation throughout the territory of CR and to raise an alarm in the case of an

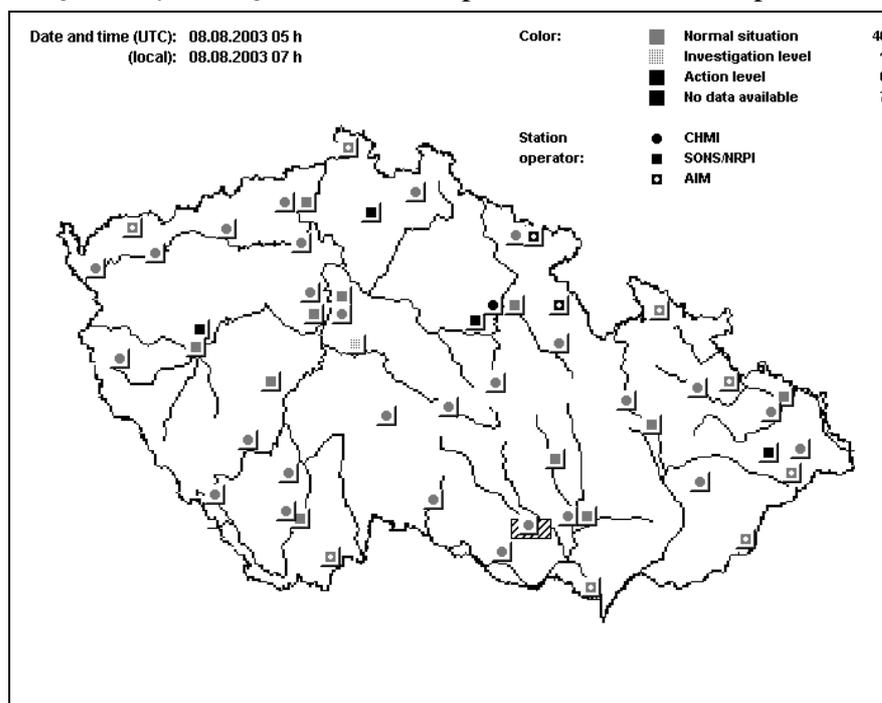
unreported accident outside the territory of CR which would have consequences for the territory of CR.

The EWN measuring sites are equipped with a two-probe system combining of a low-range probe (proportional counter) and a high-range probe (Geiger-Müller counter). The system is able to cover the dose-rate range from natural background up to values in real emergency situation in an energy range from approx. 20 keV to 2 MeV.

The EWN consists of 54 measuring sites covering the whole territory of CR, of which 38 are located at the observatories of the Czech Hydro-Meteorological Institute (CHMI), 9 at the Measuring Points of Air Contamination (MPAC) operated by NRPI and the Regional Centers (RC) of the SONS and 7 at the Measuring Points operated by Fire Brigades (FB).

Each EWN measuring site operates round-the-clock and provides values of average dose-equivalent rate over 10-minutes periods; the measuring sites operated by CHMI provide in addition basic meteorological data (temperature, atmospheric pressure, wind speed and direction, precipitation, dew-point etc.). All data (both radiation and meteorological) are transferred to the Centre of Radiation Monitoring Network (CRMN) located in SONS/NRPI.

Fig. 1: Early warning network – example of the one-hour map



The resulting overview maps (Fig.1), graphs and tables are available to the Crisis Coordination Centre (CCC) of SONS. Data are also provided for mutual exchange with Austria and for EURDEP (European Union Radiation Data Exchange Platform) system (via E-mail).

The alarm function of EWN is assured by GSM/SMS-messaging system automatically notifying a person-on-duty through a warning message any time when preset levels of dose-

equivalent rate are reached on any site. A person-on-duty can obtain more detailed information about measured values either using a remote log-in to the server of IS, or via GSM/SMS answering system, check the situation (i.e. whether the increase of dose-rate was caused by fluctuation of natural background) and adopt proper measures.

### **Information System of RMN of Czech Republic**

The IS of the RMN consists of: local applications for collecting of results of monitoring from the monitoring sites, the laboratories etc.; the data transfer system for a transfer of the data from data suppliers to the central servers; the central applications for processing, storing and presenting results of monitoring for the needs of evaluating the radiation situation in CCC, for a mutual exchange of monitoring results on both national and international levels and for publishing an information about a radiation situation.

### **TLD Territorial Network**

A main purpose of the network is to confirm normal radiation situation and to estimate external doses for population in normal and accidental radiation situation. The TLD territorial network consists of 184 monitoring points distributed on the territory of the Czech Republic; it is operated by NRPI and RC SONS. Some of the measuring points also have been installed in adjoining buildings with an intention to obtain information about the shielding effectiveness of the buildings in the case of a radiation accident. In the case of normal radiation situation a three months monitoring period is used. The TLD local networks in the surroundings of two Czech nuclear power plants (NPP) Dukovany and Temelín are operated by NRPI and the local RC, too. As for TL dosimeter, aluminium cups containing plastic cards with three  $\text{Al}_2\text{O}_3:\text{C}$  pellets are used. These cards are read by automatic Dosacus TLD reader.

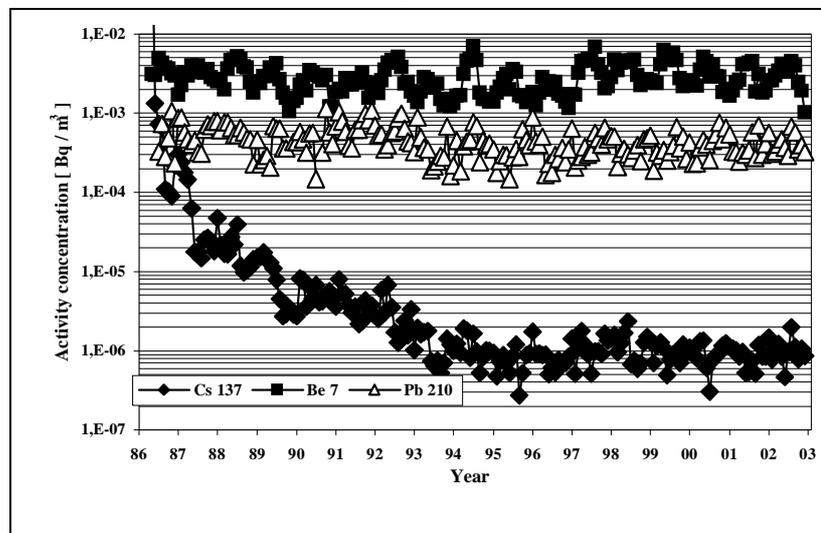
An average quarterly value of photon dose equivalent rate  $\dot{H}_X$  is calculated for each monitoring point, the values of  $\dot{H}_X$  usually range within 70 - 270 nSv/h. The investigation level of 500 nSv/h has never been exceeded and no significant changes for individual monitoring points were observed during recent years.

### **The subnetwork of the measuring sites of the air contamination**

The subnetwork of the measuring sites of air contamination consists of 10 sites equipped, besides other instruments by aerosol samplers with throughput from 40 to 900  $\text{m}^3/\text{h}$ . The samplers work continuously with one-week sampling periods. After a filtration of aerosols a part of the air is led to the cartridge with the sorbent for a sorption of gaseous radioactive iodine. The filters and the sorbent measured without any previous treatment by

semiconductor gamma-spectrometry. The aim of these measurements is not only to detect an abnormal radiation situation in co-operation with EWN, but also to follow long time trends of aerosol activity concentration. Besides artificial radionuclide  $^{137}\text{Cs}$ , natural radionuclides cosmogenic  $^7\text{Be}$  and radon progeny  $^{210}\text{Pb}$  are evaluated by gamma-spectrometry routinely for the purpose to confirm the quality of sampling and measurement in individual laboratories. After gamma spectrometric analysis the radiochemical separation followed by alpha spectrometry or beta measurements is used for the determination of  $^{90}\text{Sr}$ ,  $^{238}\text{Pu}$  and  $^{239,240}\text{Pu}$  in the quarterly combined filters from the measuring site in Prague, the continuously collection of the air for the assessment of activity concentration of  $^{85}\text{Kr}$  in monthly samples is performed here, too.

Fig. 2: The time courses of the mean monthly values of the  $^{137}\text{Cs}$ ,  $^7\text{Be}$  and  $^{210}\text{Pb}$  activity concentration in the air in Prague



The mean activity concentration of  $^{137}\text{Cs}$  in the air in CR was  $1,3 \cdot 10^{-6} \text{ Bq/m}^3$ , of  $^7\text{Be}$   $2,7 \cdot 10^{-3} \text{ Bq/m}^3$  and of  $^{210}\text{Pb}$   $3,4 \cdot 10^{-4} \text{ Bq/m}^3$  and the mean activity concentration of  $^{90}\text{Sr}$  in Prague was  $6,5 \cdot 10^{-8} \text{ Bq/m}^3$  and of  $^{85}\text{Kr}$   $1,4 \text{ Bq/m}^3$  in the year 2002. The time courses of the mean monthly values of the  $^{137}\text{Cs}$ ,  $^7\text{Be}$  and  $^{210}\text{Pb}$  concentration in Prague in the time period June 1986 - December 2002 are presented in Fig. 2.

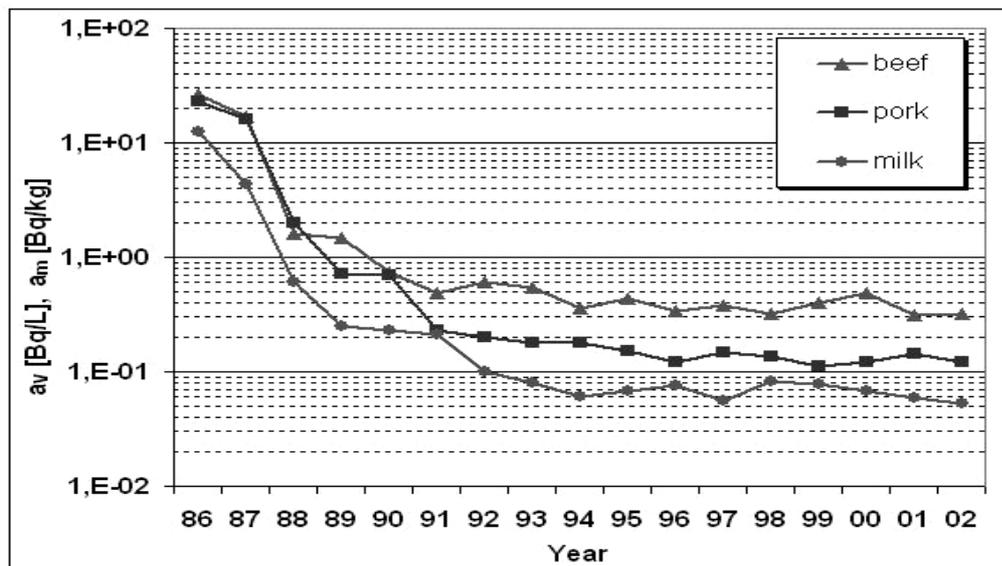
### Network of laboratories monitoring environment samples of foodstuff, water etc.

The network is constituted by 9 laboratories equipped mostly with gamma-spectrometric and radiochemical analytical instrumentation. The frequency of sampling of foodstuff and water is three months or one year (it depends on a sort of foodstuff or on analyzing radionuclide) in the normal mode of operation of RMN. Other environment samples as soils, pastures etc. are collected at request only. Except gamma ray radionuclides the content of  $^{90}\text{Sr}$  is measured in some samples and the content of  $^3\text{H}$  in water, too. To

increase the sensitivity of the determination of very low mass activities in agriculture products, the concentrate methods are used. To increase the representation of the samples, mixed samples from more regions are used.

The average values of the activity of  $^{137}\text{Cs}$  in the year 2002 were in milk 0,053 Bq/L, in beef 0,32 Bq/kg, in pork 0,12 Bq/kg (time courses of yearly average mass, resp. volume activities of  $^{137}\text{Cs}$  are in Fig. 3) and 0,06 Bq/kg in poultry. From kinds of corns from CR the highest value of the activity of  $^{137}\text{Cs}$  was found in oat (0,09 Bq/kg). For some types of samples only range of values of  $^{137}\text{Cs}$  activity was stated; the average wasn't calculated, because the most measured activities were below minimum significant activity (MSA): 0,008–0,7 Bq/kg in vegetable, 0,02–0,05 Bq/kg in fruit; due to the results don't represent the whole territory of CR: 0,6–900 Bq/kg in mushrooms and because of the data number is too low: 0,9–12 Bq/kg in wild berries. In drinking water the activity concentration of  $^{137}\text{Cs}$  was less than MSA  $3 \cdot 10^{-4}$  Bq/L (on 95% confidence level), the activity concentration  $^{90}\text{Sr}$  was  $4 \cdot 10^{-3}$  Bq/L and of  $^3\text{H}$  1,3 Bq/L. The average value of  $^{90}\text{Sr}$  activity in milk was 0,06 Bq/L and in corn 0,15 Bq/kg. All activities are in fresh weight/volume.

Fig. 3 Average year mass/volume activity of  $^{137}\text{Cs}$  in pork, beef and milk



### Ground and Airborne Mobile Groups

The mobile groups are carried on at each RC SONS, NRPI, departments of Ministry of Interior and of Ministry of Finance, NPPs Temelín and Dukovany. The mobile groups provide for mainly: mapping of radiation situation on the base of ground or airborne exploration; distribution of TL dosimeters; qualitative and quantitative assessment of radionuclides in a field (in-situ spectrometry); sampling of aerosols in a field; sampling of environment samples

(soil, vegetation, water etc.) and search of orphan's sources of ionizing radiation in the environment.

The mobile groups regularly take part in exercises in the Czech Republic, the mobile group of NRPI in international exercises, too.

### **Monitoring of the internal exposure and whole body counting**

The national survey of the internal exposure by  $^{137}\text{Cs}$  is carried out by means of measurement of the activity of  $^{137}\text{Cs}$  excreted in 24 hours urine. Samples are collected every year, usually during May and June from about 70 persons whose diet represented roughly with their diet general population of CR. The average activity of  $^{137}\text{Cs}$  excreted in 24 hours urine was 0,48 Bq in the year 2002. According to that, the calculated average content (retention) of the  $^{137}\text{Cs}$  activity in a human body was approx. 79 Bq. The estimation of the committed effective dose based on this national survey was 2,9  $\mu\text{Sv}$   $^{137}\text{Cs}$ .

A monitoring of internal exposure by  $^{137}\text{Cs}$  in a reference group of about 30 persons, mostly Prague citizens, is performed on the whole body counter (WBC) in the NRPI in Prague every year. The average activity of  $^{137}\text{Cs}$  in a person was estimated to be about 80 Bq in 2002.

### **Conclusion**

The data of RMN resulting from monitoring are transferred to the central database of CRMN, processed by the IS. They are used in normal and emergency situations for an evaluation of radiation situation and for preparation of recommendations for protection of the public and the environment. Selected results of monitoring are continuously published on web site of NRPI and summarised in the Annual Reports on Radiological Situation on the territory of the Czech Republic, issued by the NRPI.

In 2002 any extraordinary radioactivity in the environment was not detected and also none of the measuring points recorded any exceeding of established investigation levels. In components of environment and also in human beings a very low activity of  $^{137}\text{Cs}$  was still measurable, that had been released into environment after the Chernobyl accident and by the nuclear weapon tests in sixties of the last century.

### **References**

The Annual Report on Radiation Situation in the Czech Republic in 2002 (free download as <http://www.suro.cz/pub/radsit2002/zpravaors2002.pdf>), SONS, NRPI, 2003 (in Czech)