RADON PROGRAMME IN THE CZECH REPUBLIC

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Introduction

The framework of the Radon programme in the Czech republic includes both precautionary measures and interventions. The programme informally started in early eighties has been now incorporated in national legislation (Atomic Act, Radiation Protection Decree, etc.). Aim of precautionary measures is to avert construction of building above natural radiation guidance levels (200 Bq/m^3 for indoor radon concentration and 0,5 μSv/h for gamma dose rate) by protection of new buildings against soil radon ingress, by regulation of natural radioactivity in building materials and supplied water. Aim of interventions is to identify buildings affected by enhanced natural radioactivity and help owners to put into effect reasonable remedial measures. Two sets of intervention levels for indoor natural exposure were established: guidance intervention levels 400 Bq/m^3 (indoor radon), 1,0 μSv/h (indoor gamma dose rate) and limit values 4000 Bq/m^3 and 10 μSv/h.

The radon programme is based both on governmental and private activities. The governmental activities include representative and targeted indoor radon survey, subsidy for radon mitigation, mitigation test measurements and public information on radon issue. The private activities include radon measurement (radon index of building site, indoor measurements, radon diagnosis) and remedial measures. More than 100 commercial companies were authorised by Radiation Protection Authority (SUJB) to provide these measurements.

The system of precautionary measures

Precautionary measures cover monitoring and control of all potential radon sources: soil gas, building material and supplied water. The procedure is as follows: Estimation of "radon index" of building site is obligatory during siting of a new building. Radon index category - low, medium or high - is determined by set of radon in soil gas measurements (15 probes in depth 0,8m) and permeability measurements in the building site. It is not accepted to use radon geological prognosis maps of the territory, the maps are generally not detailed enough for such purposes, even in scale 1:50 000. It is obligatory to protect buildings against soil

radon in compliance with technical code taking into account radon index category of building site. Essential characteristics of different types of building materials - e.g. radon diffusion coefficient of radon proof membranes - are tested by standard procedure. It is evident however, that further research of “leakage area”, “joints” and sealing materials ought to be carried out yet.

Monitoring and regulation of natural radioactivity of building materials are the second important precautionary measure. All producers of building materials are oblige to monitor content of K^{40}, Ra^{226} and Th^{232}, evaluate I („mass activity index“) (1)

$$I = \frac{C_{Ra}}{300\ Bq\ .kg^{-1}} + \frac{C_{Th}}{200\ Bq\ .kg^{-1}} + \frac{C_{K}}{3000\ Bq\ .kg^{-1}}$$

and submit results of measurements to SUJB. Exemption level I = 0.5 was accepted for building material used in bulk amount. Producer must carry out optimisation of radiological protection and cost benefit analysis, if exemption level is exceeded. Limit level 150 Bq/kg Ra^{226} for building material used in bulk amount was set to limit radon exhalation.

Monitoring and regulation of natural radioactivity in supplied water are the last precautionary measure. Suppliers of water into public water distribution networks are required to ensure systematic measurement and evaluation of the content of natural radionuclides **(**Rn^{222}, gross alpha, gross beta). If exemption levels (50 Bq/l - Rn^{222}, 0.2 Bq/l -gross alpha, 0.5 Bq/l -gross beta) are exceeded then content of natural radionuclides must be analysed and optimisation/cost benefit analysis of possible remedial measures must be carried out. Limit values set for individual natural radionuclides cannot be exceeded in any case. There is no obligatory limit for individual water sources, values mentioned above are used only as guidance levels.

The survey of effectiveness of precautionary system was carried out in the last year. It was found out surprisingly, that indoor radon level 200 Bq/m^3 was exceeded somewhere in about 20 % of new houses. One of the reasons seems to be unexpectedly low air exchange rate in modern energy-saving houses.

The system of interventions - remedial measures

Aim of interventions is to promote radon survey in existing buildings to identify radon affected houses and help owners to put into effect reasonable remedial measures. There are both governmental and commercial activities in this issue. Governmental activities include:

- representative indoor radon survey of the country and preparing radon risk maps,
- targeted indoor radon survey,
- subsidy for radon mitigation and remedy measures,
- test of mitigation effectiveness,
- foster public awareness of radon issue.

Track detector representative survey was carried out in 1993. It was estimated that some 2-3% family houses (50 000) are above 400 Bq/m^3. Targeted indoor radon survey is under way, up to now more than 120 000 measurements in family houses and kindergartens were carried out, 20 000 of them already found above intervention level. Geological radon prognosis maps [(2)] (previously made out in scale 1:500 000, now in scale 1:50 000) are used to target radon survey mainly into radon prone areas. The philosophy of targeted survey is simple: free measurements in all "high radon risk municipalities", free representative measurements in some 10% house in others municipalities to validate radon prognosis map.

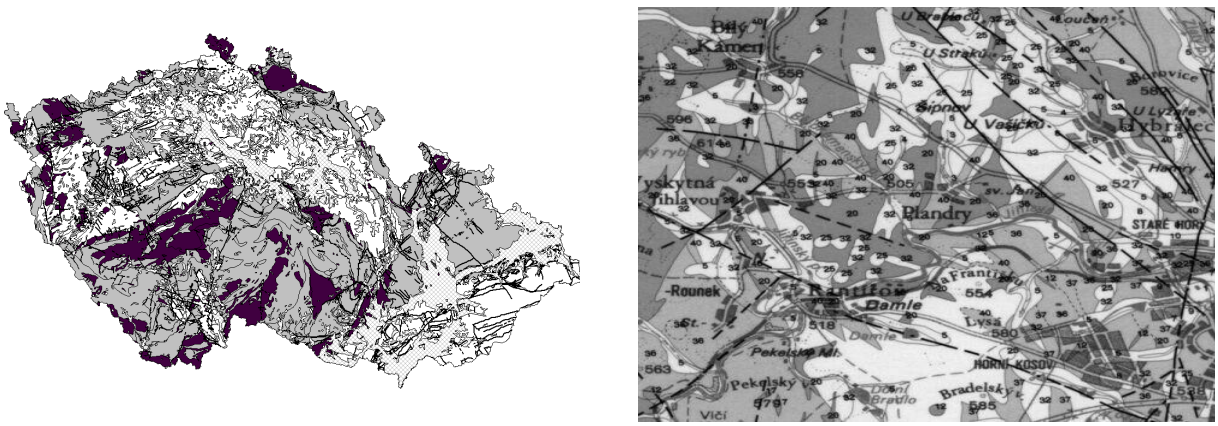

Fig.1 – Radon prognosis maps of Czech republic (scale 1:500 000 and 1:50 000)

Governmental radon mitigation subsidy

The owners of family houses or schools (indoor radon concentration above 1000 Bq/m^3) can apply for grants, typical range 500 -5000 Euro/mitigation. Radon diagnostic measurements were provided as part of remedy measure to objectify radon concentrations, identify radon sources and prepare mitigation project. Bulk of remedy measures were based

on new insulation, sub soil ventilation, computer controlled pressure air-exchange rate etc. Tests of mitigation efficiency are carried out in two steps: 1) after mitigation short- term measurements (at least one week) by commercial companies, 2) long term measurement (1 year) by track detectors provided by SURO. Malfunctions of remedial measures were investigated by SURO expert group. Unfortunately, the research of effectiveness had shown that nearly 25 % remedial measures realised within past ten years had failed from long term point of view. The new governmental radon mitigation subsidy is more restrictive now. It should be provided subsequently and only if mitigation was really successful.

Information and public awareness

The radon bulletin and special leaflets are periodically prepared to improve public awareness of radon issue. They are distributed to all Construction offices and to mayors of municipalities in radon prone areas. Special leaflets are prepared on preventive measures and remedial measures. The quantitative survey on radon awareness among Czech republic residents carried out 2 years ago showed relatively good knowledge on this topic. The question “Have you ever heard of naturally occurring gas named radon?” was answered: “Yes, I know it very well” (16 % of respondents), “I have heard something” (59%), “No” (25%).

Conclusions

There are some issues important from standpoint of practice and interesting from scientific point of view those could be topic for further research:

- the right indoor radon measurements and estimation, investigation of variability of short/long term measurements, influence of confounding factors (meteorology etc), development of new radon diagnostic methods to identify and quantify radon sources and entry rates, investigation radon permeation through the building construction,
- investigation of validity of radon mapping process in details, relation indoor radon vs. soil gas radon, influence of geology parameters and building technology,
- investigation of new mitigation methods, long term effectiveness, the role of energy saving buildings.

References

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