Establishing regional reference indoor radon level on the base of radon survey data

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Current international recommendations

- ICRP recommends new upper value of reference level for radon gas in dwellings 300 Bq/m^3 that is twice lower than previous recommendation.
- WHO proposes a reference level of 100 Bq/m^3
- The protection against ionizing radiation in existing exposure situation is achieved by application of reference levels and optimization

Reference level

- Establishing a national reference level considering local circumstances is one of the key points of current international radiological protection system
- Application of high reference level at a territory with low natural radon potential won’t result in desired reduction of mortality due to radon induced lung cancer
- We suppose to set up indoor radon reference level for sub-national regions as well as for large urban agglomerations separately

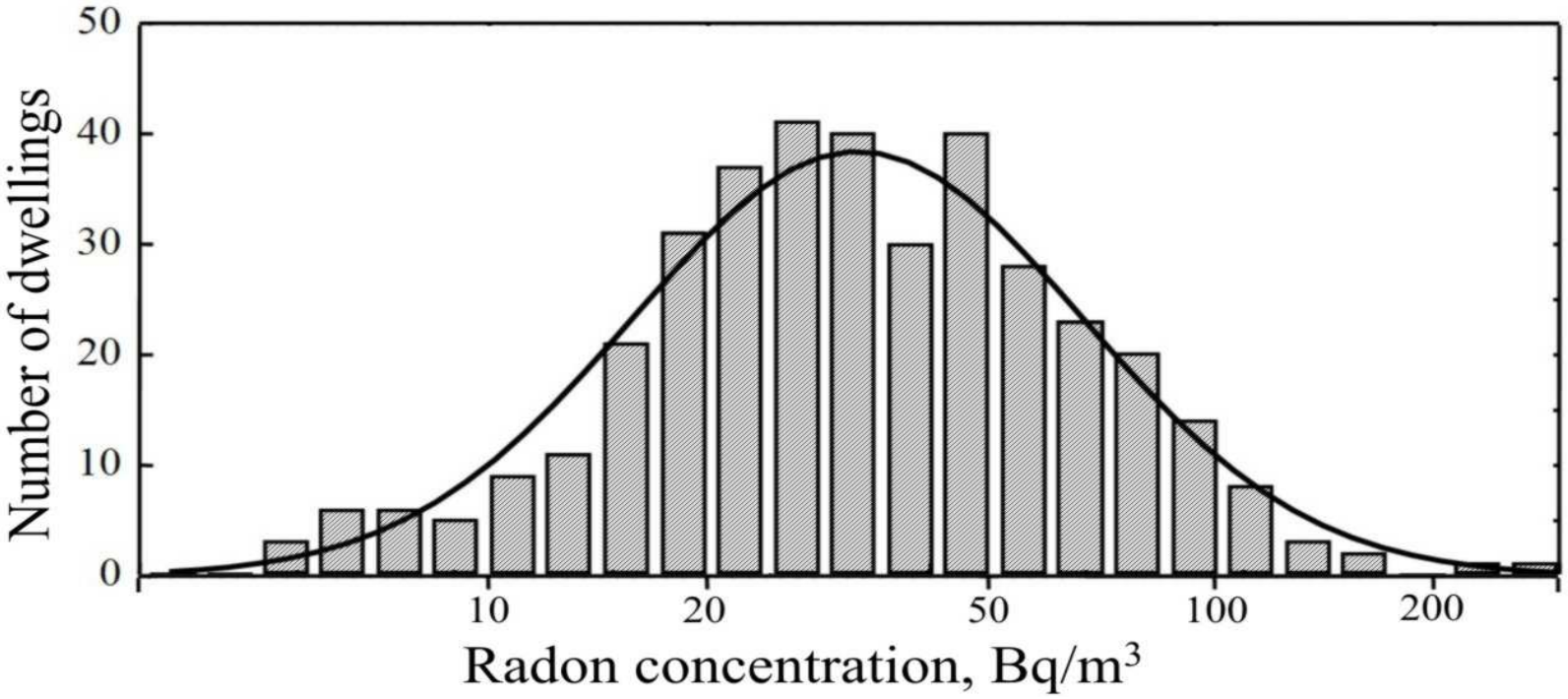
Ekaterinburg (population about 1.4 millions)

- Analysis of radon concentration by type of building, year of construction, building material, floor and other factors influencing indoor radon concentration provide data to found the reference level.

Methodology of radon survey

- Measurements were performed in 404 apartments (duration of exposure of radon detectors was 3 month)
- The quality of a sample of dwellings was controlled by the uniformity of object's location on the city territory and the coverage of the main types of buildings
- In 43 dwellings the whole year measurements were carried out to analyze seasonal variations
- Total uncertainty of measurement conducted by single solid-state track detectors (Kodak film LR-115 type 2) was estimated as 30%

Results. Lognormal distribution.
$\chi 2=10.1$; df = 15; p=0.81



Results

- Arithmetic mean of radon concentration – 42 Bq/m^3,
- Geometric mean – 30 Bq/m^3
- GSD=2.3
- Expected fraction of dwellings with radon concentration above national action level 400 Bq/m^3 is 0.1%.
- Differences in average levels of radon accumulation at different districts were not statistically significant ($p > 0.05$)

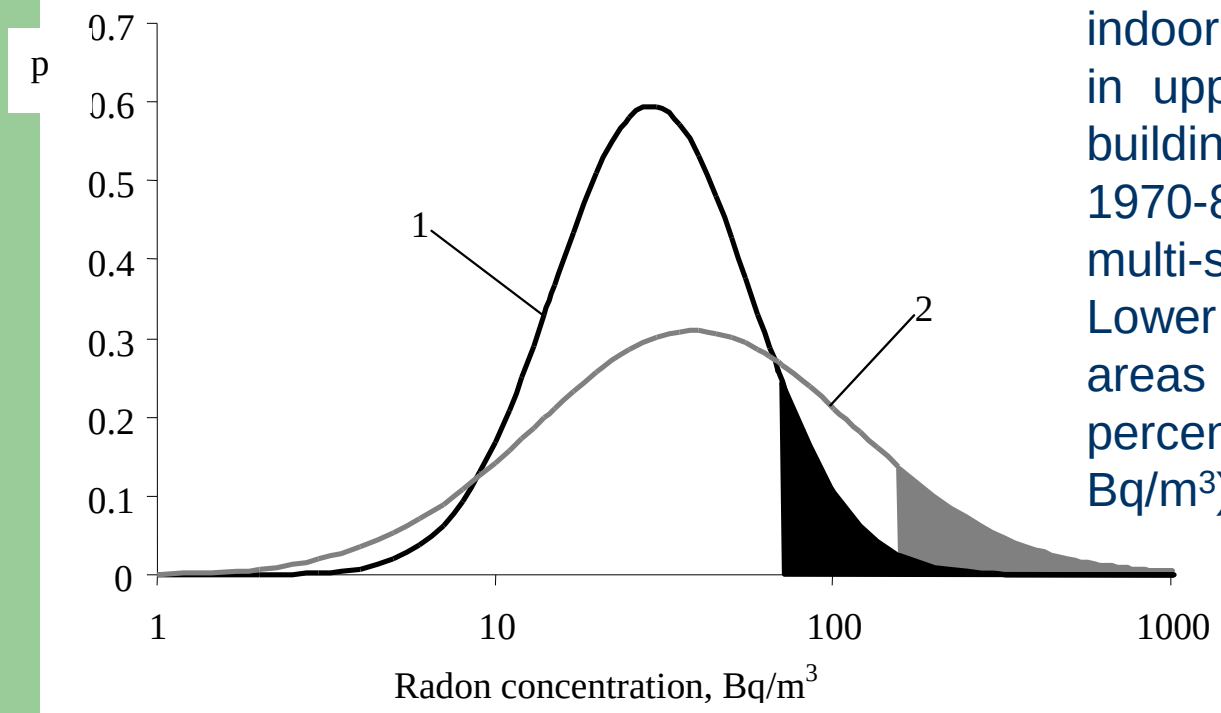
Radon concentration for different types of dwellings

Type of dwellings	Arithmetic mean, Bq/m^3	Geometric mean, Bq/m^3	GSD	Percentage above 100 Bq/m^3	Percentage above 200 Bq/m^3	Percentage above 400 Bq/m^3
Buildings constructed in 1950-1969						
ground floor	81	41	3.8	25.2%	11.8%	4.5%
upper floors	37	28	2.3	6.5%	1.0%	0.08%
Buildings constructed in 1970-1989						
ground floor	50	39	2.1	10.2%	1.4%	0.09%
upper floors	35	29	2.0	3.1%	0.2%	0.005%
Buildings constructed after 1990						
upper floors	51	34	2.6	13.1%	3.3%	0.5%

Critical group of dwelling: multi-storey monolithic or brick buildings of modern construction (21 apartsments)

- arithmetic mean – 65 Bq/m^3;
- geometric mean of – 39 Bq/m^3;
- GSD =3.0;
- expected fraction of dwellings with radon concentration above action level of 200 Bq/m^3 – 6.5%.

Establishing the regional indoor radon reference level



Expected distributions of indoor radon concentrations in upper floor dwellings in buildings constructed in 1970-80-s (1) and in new multi-storey buildings (2). Lower borders of shaded areas represent 90-th percentiles (70 and 160 Bq/m^3).

Establishing the regional indoor radon reference level

We propose to establish the regional reference level for indoor radon concentration at a value associated with 90-th percentile of radon concentration in representative group of buildings demonstrating the best practice in the field of the population protection. For Ekaterinburg this value corresponds to 70 Bq/m^3.

Thank you for attention