Calibration under low-level of radon activity concentration

ELIŠKA FIALOVÁ[1,2], PETR OTÁHAL[1], JOSEF VOŠAHLÍK[1]

[1]National institute for NBC protection (SÚJCHBO, v.v.i.), Kamenná, Czech Republic

[2]Faculty of Science, Masaryk University in Brno, Czech Republic

September 2021

Introduction

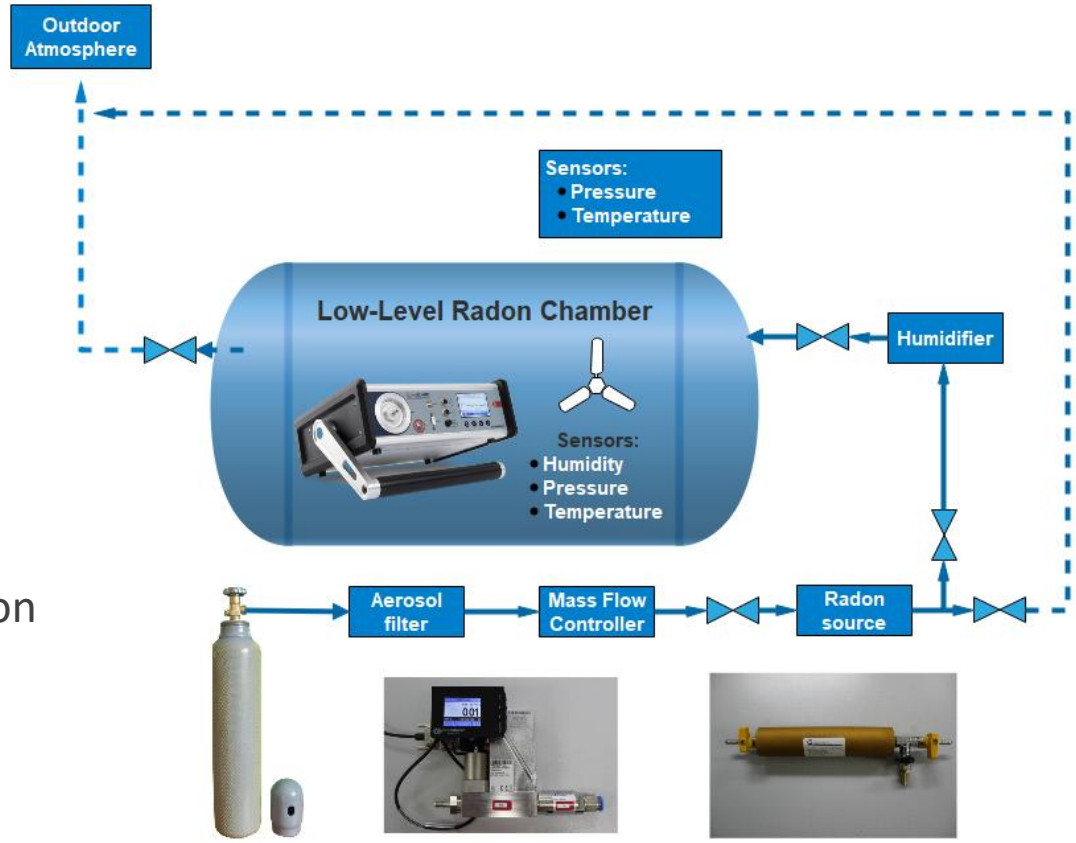
- Radon measurement techniques are simple, efficient and precise to evaluation the radon activity concentration in indoor or in soil air.
- Nevertheless the levels of relevant activity concentration in European dwellings are laid down (300 $Bq \cdot m^{-3}$).
- So the task of developing and accuracy improving new and current calibration procedures for existing commercial radon monitor is still actual.
- Low-level radon chambre (MetroRadon, 100 – 300 $Bq \cdot m^{-3}$)
- Low-level radon source (TraceRadon, 1 – 100 $Bq \cdot m^{-3}$)

Low-level radon chamber

Achieving of low-level radon activity concentration:

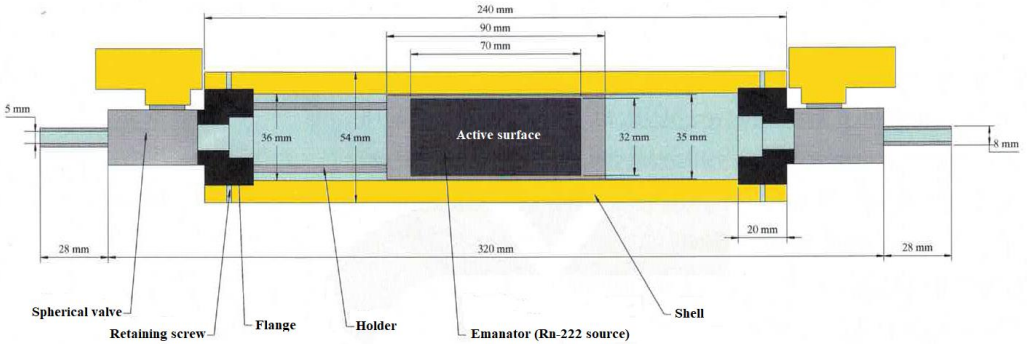
- Constant dotting of radon
- Defined ventilation
- Radon free air (specific atmospheric condition in the SÚJCHBO areal)
- Model of constant radon input and constant ventilation

$$a(t) = a_o \, . e^{-(\lambda+k).t} + \frac{R}{V(k+\lambda)}\left(1 - e^{-(\lambda+k).t}\right)$$



Low-level radon source RF-1 (CMI)

- Stainless steel cylindrical case, ball valves
- Steel tray with Ra-226 placed in the middle of this cylindrical case - radon releases from this thin layer
- Flow-through mode (maximum flow rate 10 l/min)
- The emanation coefficient was determined by measuring the activity of the RnDP (Pb-214/Bi-214) - the emanation power is almost equal to 1



Český metrologický institut
Okružní 31, 638 00 Brno
tel. +420 545 555 111
www.cmi.cz

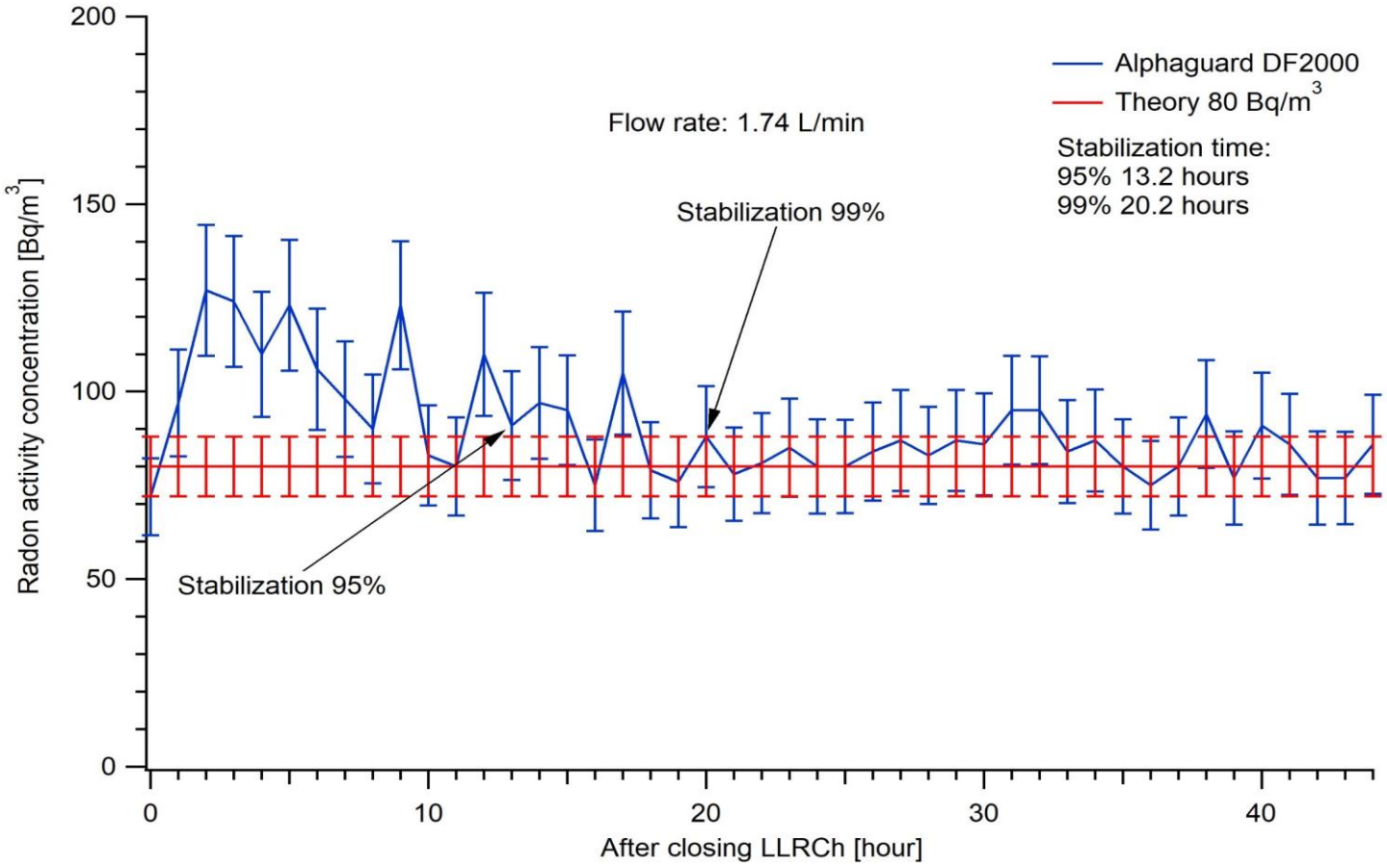
Pracoviště: Oblastní inspektorát Praha, Radiová 1136/3, 102 00 Praha 10
Oddělení výroby standardních radionuklidových zdrojů, Radiová 1288/1a
tel. +420 266 020 460

CERTIFIKÁT
etalonu aktivity

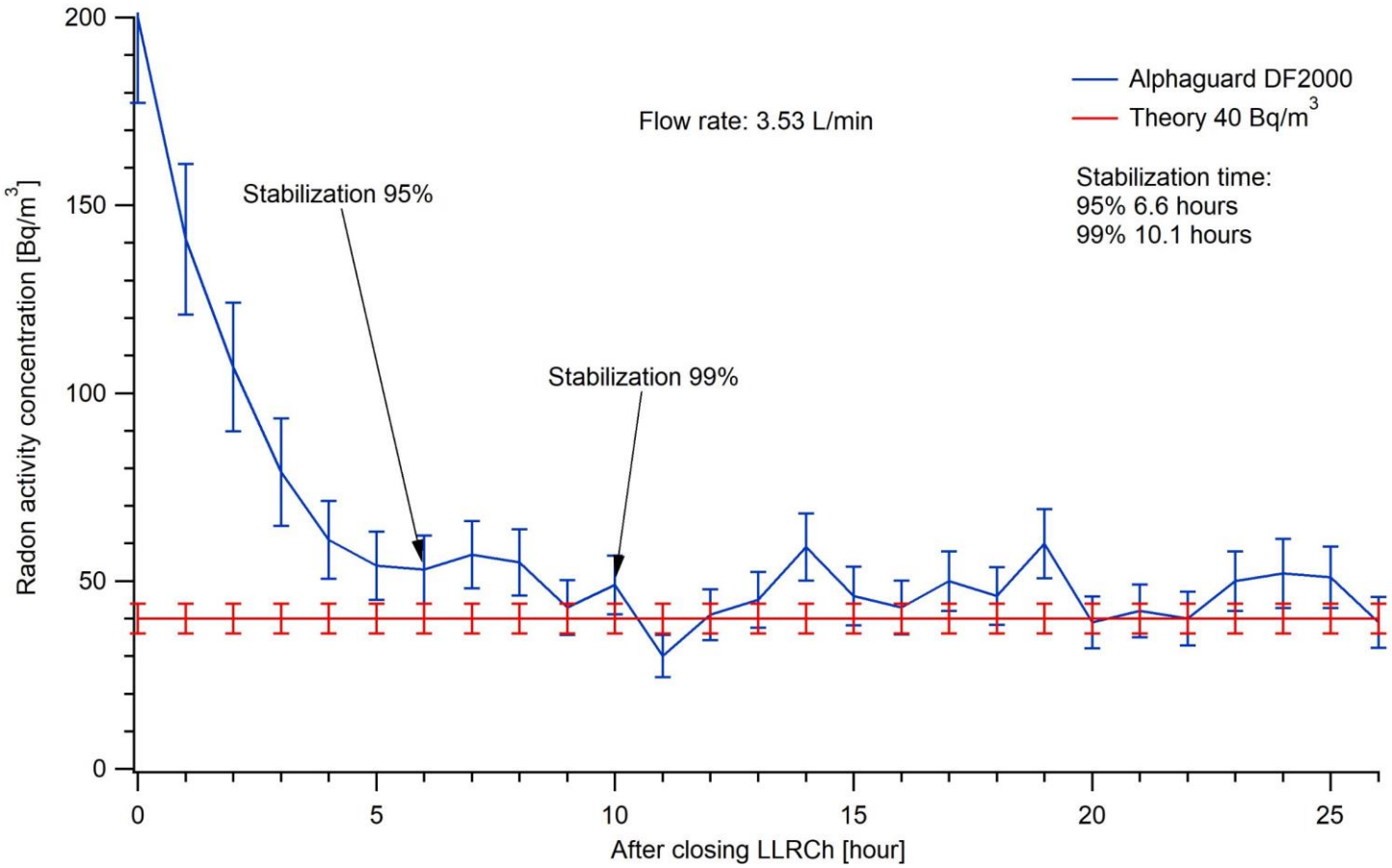
Číslo certifikátu: 1035-SE-40175-21 **Typ: RF 1** **Výrobní číslo: 230321-221458**

Radionuklid: Ra-226
Poločas Ra-226: 1600 (7) let
Aktivita: 1,136 (17) kBq
Poločas Rn-222: 3,8232 (8) dní
Radonová výdejnost: 0,0023 (1) Bq/s
Emanační schopnost: 0,9552 (19)
Radionuklidové nečistoty: -
Vnitřní objem mezi ventily: 200 (5) cm^3
Referenční datum: 1. 4. 2021

Low-level Rn-222 emanating sources – initial tests for 80 Bq·m^{-3}

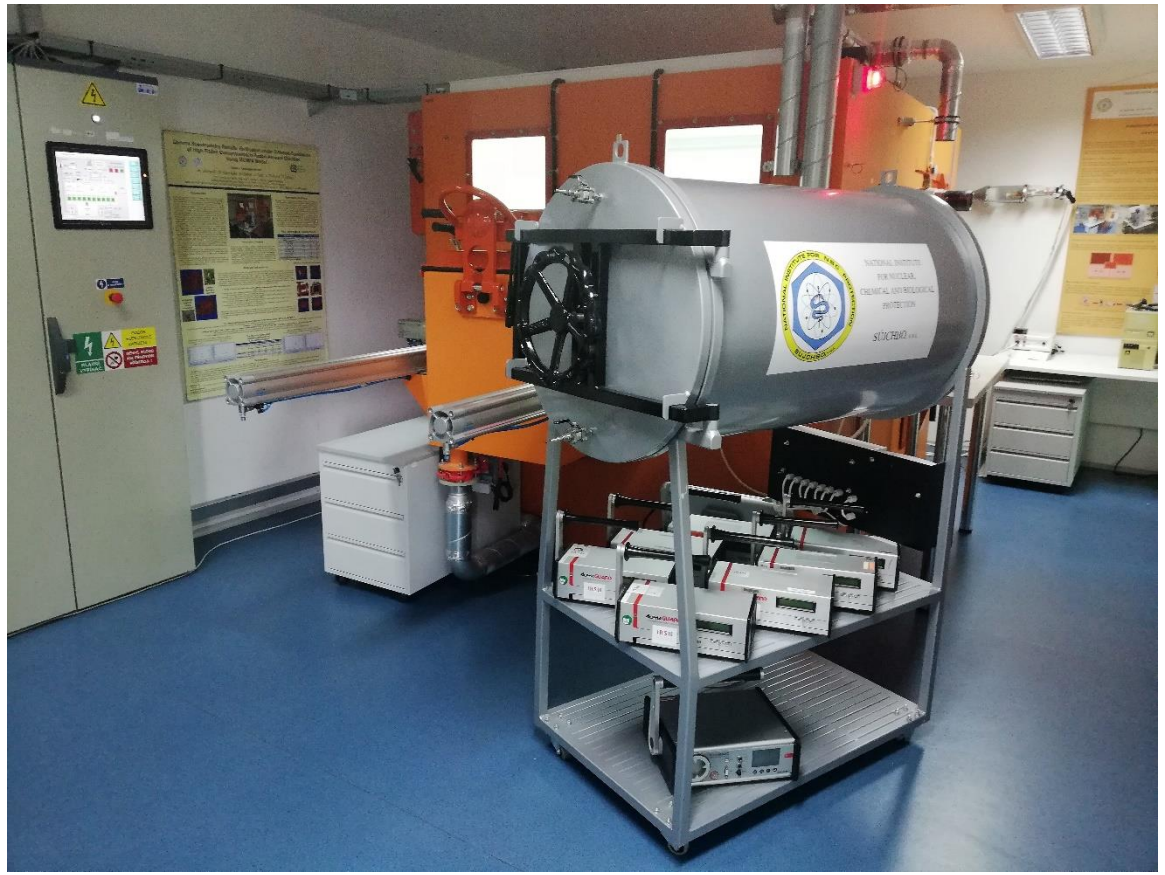


Low-level Rn-222 emanating sources – initial tests for 40 Bq·m^{-3}



Calibration laboratory SÚJCHBO

- Authorized by the Czech Office for Standards, Metrology and Testing
- Accredited by the Czech Accreditation Institute (100 Bq·m^{-3} – 2 MBq·m^{-3})
- Certified by Lloyd´s Register Quality Assurance



Calibration of radon in soil gas devices in the framework of GARRM 2021

Continual monitors

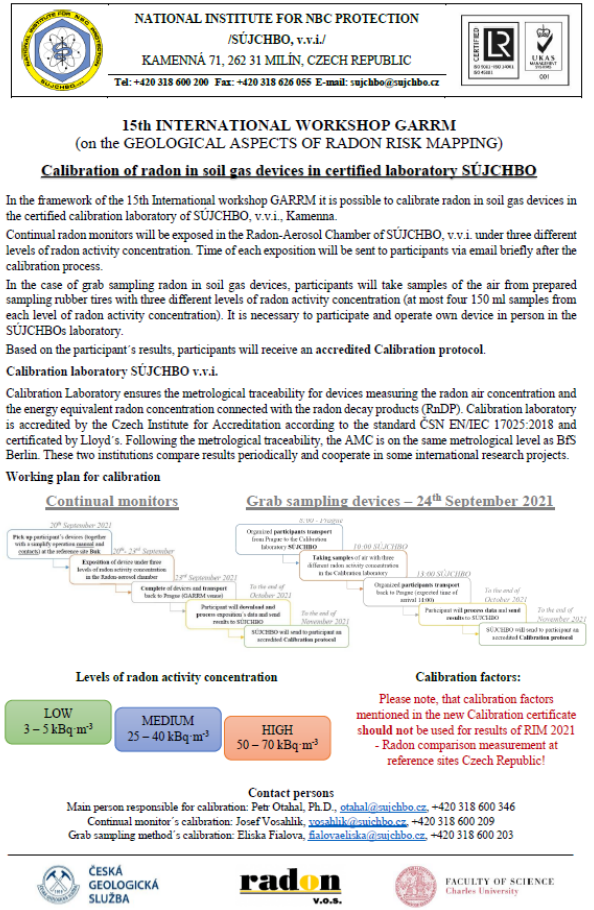
Grab sampling methods

Please note, that calibration factors mentioned in the new Calibration certificate **should not** be used for results of RIM 2021 - Radon comparison measurement at reference sites Czech Republic!

LOW
3 – 5 kBq·m^{-3}

MEDIUM
25 – 40 kBq·m^{-3}

HIGH
50 – 70 kBq·m^{-3}



NATIONAL INSTITUTE FOR NBC PROTECTION
/SÚJCHBO, v.v.i./
KAMENNÁ 71, 262 31 MILÍN, CZECH REPUBLIC
Tel: +420 318 600 200 Fax: +420 318 626 055 E-mail: sujchbo@sujchbo.cz

15th INTERNATIONAL WORKSHOP GARRM
(on the GEOLOGICAL ASPECTS OF RADON RISK MAPPING)

Calibration of radon in soil gas devices in certified laboratory SÚJCHBO

In the framework of the 15th International workshop GARRM it is possible to calibrate radon in soil gas devices in the certified calibration laboratory of SÚJCHBO, v.v.i., Kamenna.

Continual radon monitors will be exposed in the Radon-Aerosol Chamber of SÚJCHBO, v.v.i. under three different levels of radon activity concentration. Time of each exposition will be sent to participants via email briefly after the calibration process.

In the case of grab sampling radon in soil gas devices, participants will take samples of the air from prepared sampling rubber tires with three different levels of radon activity concentration (at most four 150 ml samples from each level of radon activity concentration). It is necessary to participate and operate own device in person in the SÚJCHBOs laboratory.

Based on the participant's results, participants will receive an **accredited Calibration protocol**.

Calibration laboratory SÚJCHBO v.v.i.

Calibration Laboratory ensures the metrological traceability for devices measuring the radon air concentration and the energy equivalent radon concentration connected with the radon decay products (RnDP). Calibration laboratory is accredited by the Czech Institute for Accreditation according to the standard ČSN EN/IEC 17025:2018 and certificated by Lloyd's. Following the metrological traceability, the AMC is on the same metrological level as BfS Berlin. These two institutions compare results periodically and cooperate in some international research projects.

Working plan for calibration

Continual monitors

Grab sampling devices – 24th September 2021

Levels of radon activity concentration

LOW 3 – 5 kBq·m^{-3} | MEDIUM 25 – 40 kBq·m^{-3} | HIGH 50 – 70 kBq·m^{-3}

Calibration factors:

Please note, that calibration factors mentioned in the new Calibration certificate **should not** be used for results of RIM 2021 - Radon comparison measurement at reference sites Czech Republic!

Contact persons

Main person responsible for calibration: Petr Otahal, Ph.D., otahal@sujchbo.cz, +420 318 600 346
Continual monitor's calibration: Josef Vosahlik, vosahlik@sujchbo.cz, +420 318 600 209
Grab sampling method's calibration: Eliska Fialova, fialovaelicka@sujchbo.cz, +420 318 600 203

ČESKÁ GEOLOGICKÁ SLUŽBA | radon v.o.s. | FACULTY OF SCIENCE Charles University

Thanks for your attention!

The project 19ENV01 TraceRadon has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. 19ENV01 traceRadon denotes the EMPIR project reference.