Projekt MetroRADON Metrology for Radon Monitoring

Centralne Laboratorium Ochrony Radiologicznej

Katarzyna Wołoszczuk, Zuzanna Baranowska
Seminaria CLOR| 01.04.2021

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MetroRADON

EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Projekt MetroRadon

- początek 1 czerwca 2017 r.
- czas trwania: 3 lata
- koordynator: Hannah Wiedner (Hannah.Wiedner@bev.gv.at),
- 17 instytucji uczestniczących w projekcie
- projekt EMPIR organizowany przez EURAMET
- finansowany przez H2020 oraz EMPIR Participating States

Uczestnicy projektu

MetroRADON

8 Internal Funded Partner

- BEV-PTP (Austia)
- VINCA (Serbia)
- STUK (Finlandia)
- MKEH (Węgry)
- CEA (Francja)
- IFIN-HH (Rumunia)
- CMI (Czechy)
- PTB (Niemcy)

9 External Funded Partner

- BfS (Niemcy)
- IRSN (Francja)
- JRC (Europe)
- SUN (Bułgaria)
- SUJCHBO (Czechy)
- AGES (Austria)
- **CLOR (Polska)**
- UC (Hiszpania)
- METAS (Szwajcaria)

Uczestnicy projektu

Cele

- development of novel procedures for the traceable calibration of radon (^{222}Rn) measurement instruments at low activity concentrations (100 Bq/m^3 to 300 Bq/m^3) with relative uncertainties ≤ 5 % (k=1) As part of this, to develop new radioactive reference sources with stable and known radon emanation rates,
- influence of thoron (^{220}Rn) and its progeny on radon end-user measurements and radon calibrations,
- comparison and harmonization of radon measurement procedures in Europe,
- study methodologies for the identification of radon priority areas and relationship between soil Rn exhalation and indoor Rn concentrations,
- validation of traceability of European radon calibration facilities.

Struktura

Podział na pakiety robocze

WP 1 Development of novel procedures for the traceable calibration of radon (^{222}Rn) measurement instruments at low radon concentrations

WP 2 Influence of thoron (^{220}Rn) and its progeny on radon end-user measurements and radon calibrations

WP 3 Comparison and harmonization of radon measurement procedures in Europe

WP 4 Radon priority areas

WP 5 Validation of traceability of European radon calibration facilities

WP1

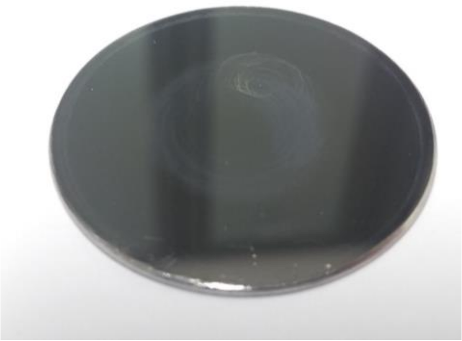
Development of novel procedures for the traceable calibration of radon (^{222}Rn) measurement instruments at low activity concentrations (100 Bq/m^3 to 300 Bq/m^3) with relative uncertainties ≤ 5 % (k=1) As part of this, to develop new radioactive reference sources with stable and known radon emanation rates.

- Task 1.1: Development of new radioactive reference sources with stable and known radon emanation capacity
- Task 1.2: Comparison of radon gas standards
- Task 1.3: Establishment of constant radon activity concentrations in Reference chambers and calibration of measurement instruments

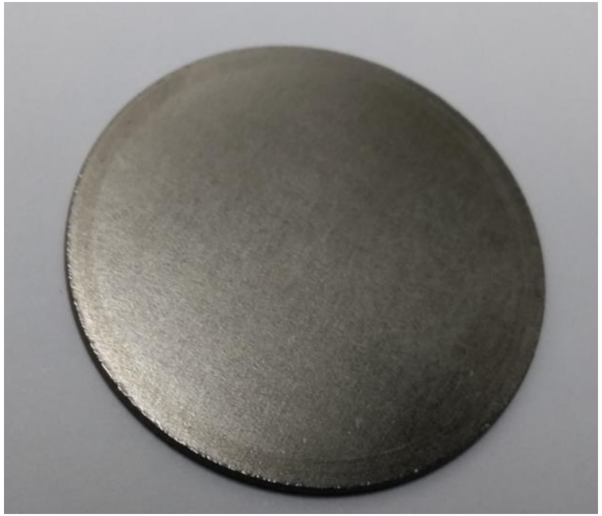
WP1

First Results – Design of new sources

Flow-through source, CMI



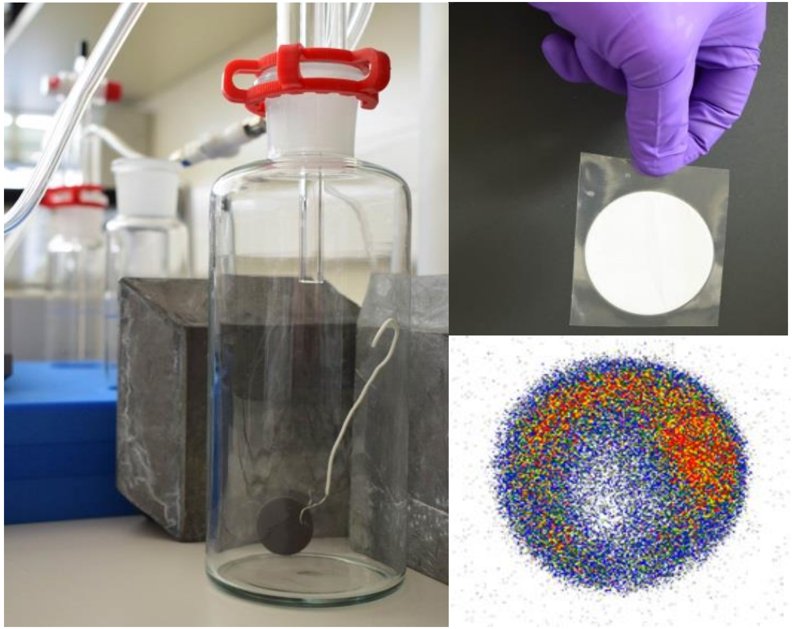
Electrodeposited Source, PTB
Deposition at 30 V < U < 200 V



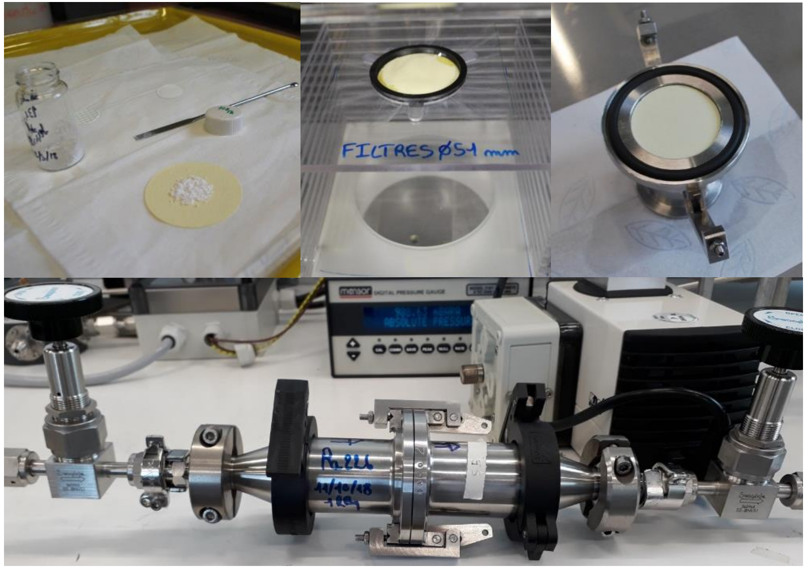
Implanted Source, PTB
Implantation of mass-resolved Ra-226 at 30 keV into W and Al

WP1

Chemisorption, JRC

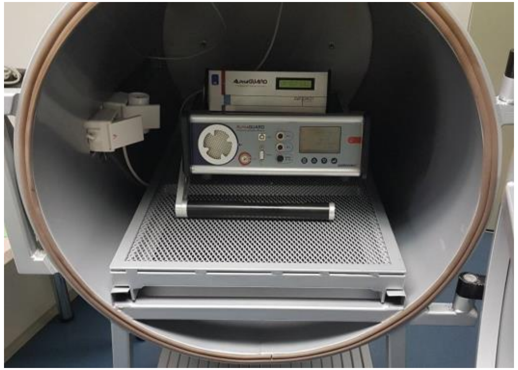


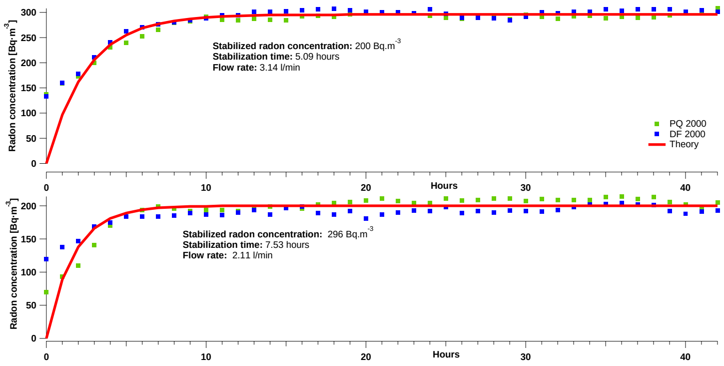
^{220}Rn flow-through source, CEA



WP1

- Installed in radon chambers
- Establishment of constant and traceable 222Rn activity concentrations
- Evaluation of
  - stability and reproducibility of atmospheres under environmental conditions
  - stable and repeatable radon atmospheres in the range between 100 Bq/m³ and 300 Bq/m³
- Goal: Development of novel traceable calibration procedures



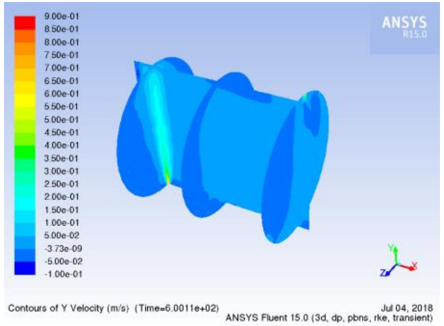


WP2

Influence of thoron (^{220}Rn) and its progeny on radon end-user measurements and radon calibrations

- Task 2.1: Organization and execution of a consortium exercise to ensure traceability of the secondary reference instruments used in the experimental research (AlphaGUARDRnTnPro, RAD 7) to the primary thoron system at IRSN, Saclay, France
- Task 2.2: Studies of the influence of thoron on radon measurements and calibrations
- Task 2.3: Development of methods to reduce the influence of thoron on radon measurements and calibrations

First Results – Homogeneity testing of thoron atmosphere



Numerical Modelling

ANSYS package v. 15 to 18

Geometry : SPACECLAIM

Mesh : Meshing

Flow solver : FLUENT

LSC of aerogel

SSNTDs of LR-115/II

METHODS FOR EXPERIMENTAL STUDY OF HOMOGENITY IN ^{220}RN CALIBRATIONS

K. Mitev[1,*], P. Cassette[2], D. Pressyanov[1], S. Georgiev[1], Ch. Dutsov[1], N. Michielsen[3], B. Sabot[2]

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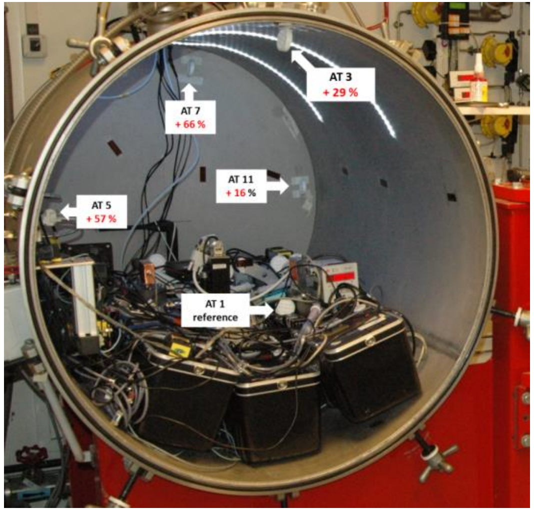
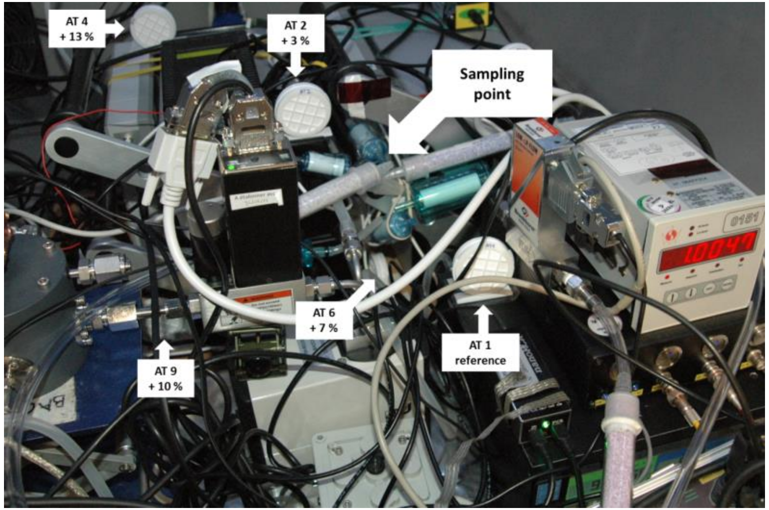
[2] *CEA, LIST, Laboratoire National Henri Becquerel (LNE-LNHB), 91191 Gif-sur-Yvette Cedex, France*
[3] *Institut de Radioprotection et de Sûreté Nucléaire (IRSN), 92262 Fontenay aux Roses, France*

Keywords: **Thoron calibration, thoron homogeneity, LSC, nuclear track detectors**

Accepted abstract ICRM'19

First Results – Calibration of radon/thoron monitors





The ratio between the thoron activity concentrations and the reference activity concentration have been found close to one for the AlphaGUARD and around 0.6 for the RAD7.

First Results – Field measurements to assess influence of thoron

WP3

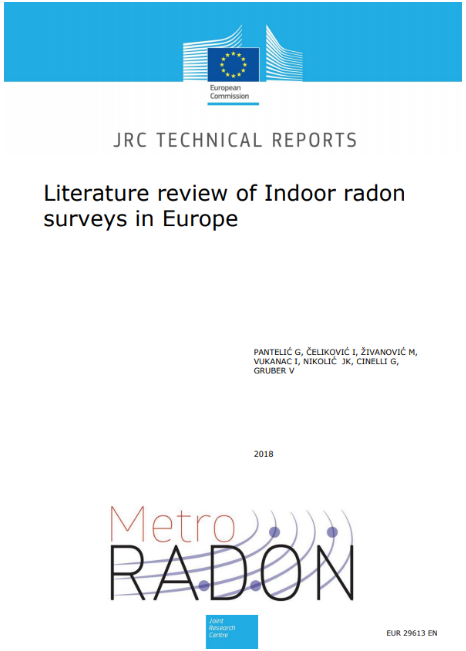
Comparison and harmonization of radon measurement procedures in Europe

- Task 3.1: Radon Indoor surveys in Europe: description and comparison
- Task 3.2: Geogenic radon surveys in Europe: description and comparison
- Task 3.3: Intercomparisons exercises at field conditions
- Task 3.4: Harmonization of indoor and geogenic radon data

WP3

First Results – Analysis of indoor radon surveys in Europe

- Literature review of Indoor radon surveys in Europe published as JRC Technical Report
- Questionnaires on indoor and geogenic radon surveys


European Commission

JRC TECHNICAL REPORTS

Literature review of Indoor radon surveys in Europe

PANTELIĆ G, ČELIKOVIĆ I, ŽIVANOVIĆ M, VUKANAC I, NIKOLIĆ JK, CINELLI G, GRUBER V

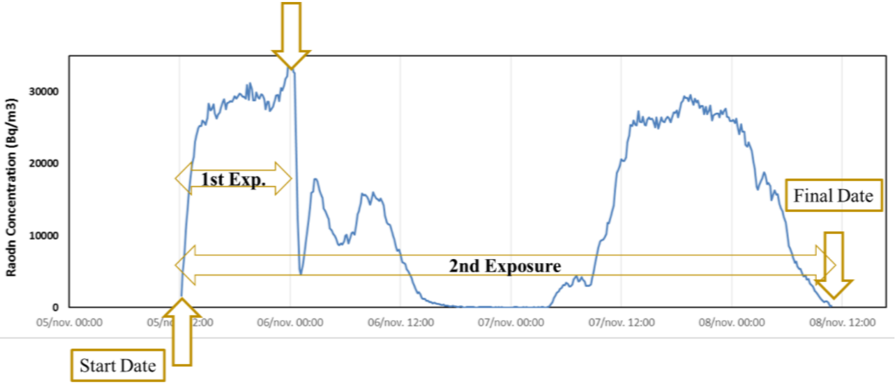
2018

Joint Research Centre

EUR 29613 EN

First Results – Intercomparison Exercise

- Radon exposure in air for active and passive Rn detectors
- Radon in soil and radon exhalation from soil
- Maximum participants reached



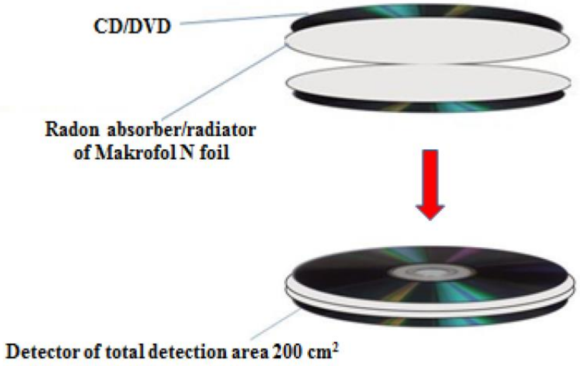
WP4

Radon priority areas

- Task 4.1: Concepts for the definitions of Rn priority areas
- Task 4.2: Relationship between indoor Rn concentration and geogenic Rn
- Task 4.3: New developments in estimation of Rn priority areas
- Task 4.4: Harmonization of radon priority areas across borders

First Results – CDs/DVDs as radon detectors

- Use of CDs/DVDs as (retrospective) radon detectors
- Long-term exposure of CDs started in September 2017
- Measured range 222Rn concentration range: < 10 Bq/m3 – 147 300 Bq/m3
- Development of modified detector using Makrofol N

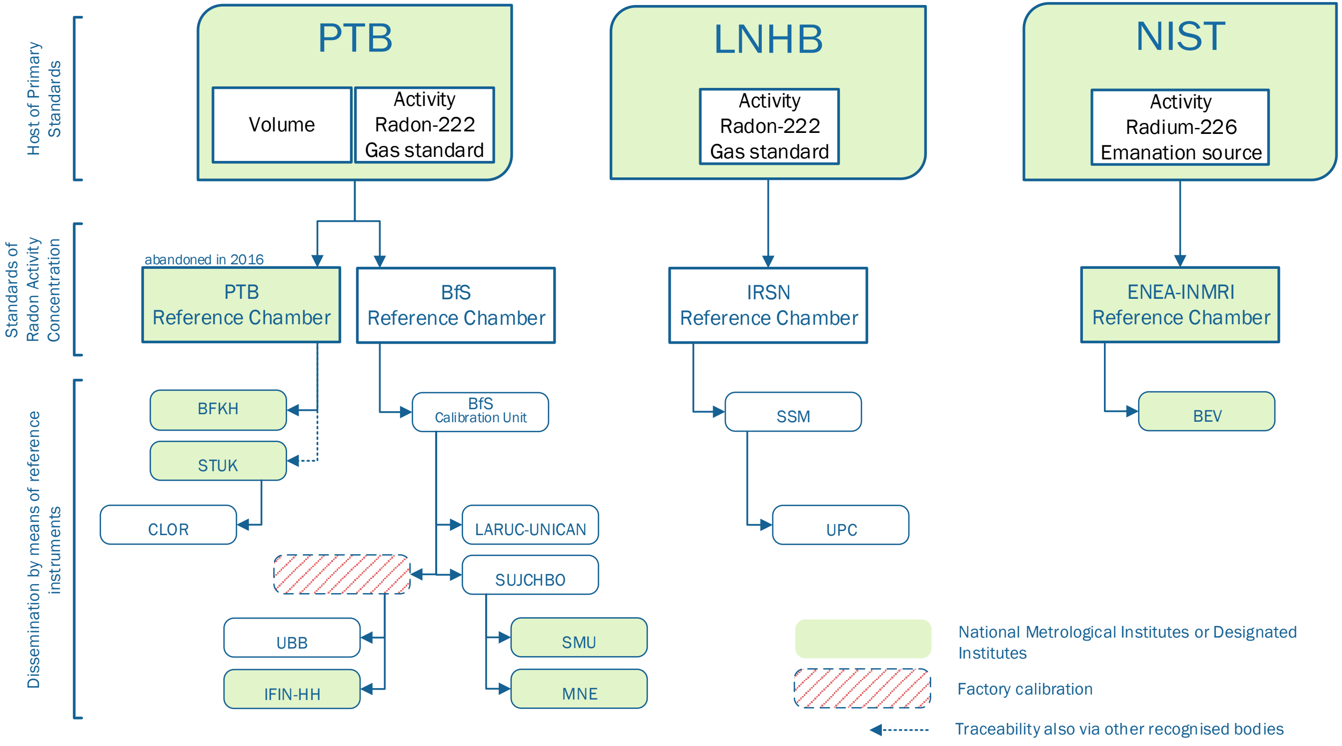


WP5

Validation of traceability of European radon calibration facilities

- Task 5.1: Selection and evaluation of European radon calibration facilities for validation of traceability
- Task 5.2: Validation of traceability, performance and precision of European radon calibration facilities
- Task 5.3: Validation of traceability of European radon calibration facilities at stable radon atmosphere in the range from 100 Bq/m3 to 300 Bq/m3

WP 5



2018/2019

Deliverables

www.metroradon.eu

- ResearchGate:

MetroRADON - Metrology for Radon Monitoring (EMPIR 16ENV10)

F. J. Maringer · Philippe Cassette · Nathalie Michielsen · Show all 41 collaborators

Goal: 1. Development of novel procedures for the traceable calibration of radon (222Rn) measurement instruments at low activity concentrations (100 Bq/m3 to 300 Bq/m3) with relative uncertainties ≤ 5 % (k=1)

Deliverables and Activity Reports

Workpackage 1 – Development of novel procedures for the traceable calibration of radon (^{222}Rn) measurement instruments at low activity concentrations:

Deliverable 1 – Method for the traceable calibration of radon (222Rn) measurement instruments at low activity concentrations

Activity report 1.2.2 – EURAMET Project N 1475 International comparison of activity measurements of radon 222 EURAMET.RI(II)-S8.Rn-222 Draft B

Workpackage 2 – Influence of thoron (^{220}Rn) and its progeny on radon end-user measurements and radon calibrations:

Deliverable 2 – Report on the influence of thoron on radon monitors used in Europe

Activity report 2.3.1 – Review of potential techniques and materials to reduce the influence of thoron on radon measurements and calibrations

Workpackage 3 – Comparison and harmonisation of radon measurement methodologies in Europe:

Deliverable 3 – Report on indoor and geogenic radon surveys in Europe

Deliverable 4 – Report on the results from the on-site comparison of indoor radon measurements and geogenic radon measurements under field conditions

Activity report 3.1.1 – Literature review of indoor radon surveys in Europe, JRC Report, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97643-8 (online), https://doi.org/10.2760/977726

Activity report 3.3.4 – Intercomparison of indoor radon and geogenic radon measurements under field conditions

Workpackage 4 – Radon priority areas (RPAs) and the development of the concept of a "Geogenic Radon Hazard Index" (RHI):

Deliverable 5 – Report and guideline on the definition, estimation and uncertainty of radon priority areas (RPA)

Deliverable 6 – Report on the concept and establishment of a Radon Hazard Index (RHI) including an RHI map of Europe

Activity report 4.1.2 – Review and Evaluation of the concepts of the definitions of radon priority areas

Activity report 4.2.3 – Relationship between indoor radon concentration and geogenic radon

Activity report 4.3.2 – Intercomparison exercise on indoor radon at LNR Saelices el Chico (Salamanca, Spain)

Activity report 4.4.2 – Radon mapping exercise

Workpackage 5 – Validation of traceability of European radon calibration facilities:

Deliverable 7 – Validation report on the traceability of primary and secondary radon calibration facilities in Europe

Deliverable 8 – Guideline and recommendations on calibration and measurement procedures for the determination of radon concentration in air

Workpackage 6 – Creating impact:

Activity report 6.3.2 – Network of European callibration laboratories for radon concentration in air measurement

Activity report 6.3.4 – Guideline on the constituents of the chain "from primary standards to radon maps" (traceability) and the links between them

Journal Publications

- Jobbágy, V., Marouli, M. & Stroh, H. Preparation of multi-purpose radon emanation sources. J Radioanal Nucl Chem (2021). https://doi.org/10.1007/s10967-021-07630-1
- Pressyanov, D., Dimitar D. 2020. The Problem with Temperature Dependence of Radon Diffusion Chambers with Anti-Thoron Barrier. Rom. J. Phys. 65, 801 (2020) http://www.nipne.ro/rjp/2020_65_1-2/RomJPhys.65.801.pdf
- Fialova, E., Otahal, P., Vosahlik, J., Mazanova, M. 2020. Equipment for Testing Measuring Devices at a Low-Level Radon Activity Concentration. Int. J. Environ. Res. Public Health (17), 1904. https://www.mdpi.com/1660-4601/17/6/1904
- Rabago, D., Fuente, I., Celaya, S., Fernandez, A., Fernandez, E., Quindos, J., Pol, R., Cinelli, G., Quindos, L., Sainz, C. 2020. Intercomparison of Indoor Radon Measurements Under Field Conditions In the Framework of MetroRADON European Project. Int. J. Environ. Res. Public Health *17*(5), 1780. https://doi.org/10.3390/ijerph17051780
- Otahal, P., Burian, I., 2020. Remarks to history of radon activity concentration metrology. Nukleonika 65(1), p. 45-49. http://www.nukleonika.pl/www/back/full/vol65_2020/v65n1p045f.pdf
- Maringer FJ., Wiedner H. and Cardellini F., 2020. An innovative quick method for tracable measurement of radon-222 in drinking water. Applied Radiation and Isotopes 155, 108907. https://doi.org/10.5281/zenodo.3555047
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- Bossew, P., 2019. Radon priority areas and radon extremes – Initial statistical considerations. Radiation Environment and Medicine 8(2), 94-104. http://crss.hirosaki-u.ac.jp/wp-content/files_mf/1568795052Web_REMVol828_PeterBossew.pdf
- Georgiev, S., Mitev, K., Dutsov, C., Boshkova, T., Dimitrova, I., 2019. Partition Coefficients and Diffusion Lengths of ^{222}Rn in Some Polymers at Different Temperatures. International Journal of Environmental Research and Public Health 16(22), 4523. https://doi.org/10.3390/ijerph16224523
- Pressyanov, D., Santiago Quindos Poncela, L., Georgiev, S., Dimitrova, I., Mitev, K., Sainz, C., Fuente, I., Rabago, D., 2019. Testing and calibration of CDs as radon detectors at highly variable radon concentrations and temperatures. International Journal of Environmental Research and Public Health 16(17), 3038. https://doi.org/10.3390/ijerph16173038
- Pantelić, G., Čeliković, I., Živanović, M., Vukanac, I., Nikolić, JK., Cinelli, G., Gruber, V., 2019. Qualitative overview of indoor radon surveys in Europe. Journal of Environmental Radioactivity 204, p. 163-174. https://doi.org/10.1016/j.jenvrad.2019.04.010
- Bossew, P., Radon Priority Areas – Definition, Estimation and Uncertainty, Nuclear Technology and Radiation Protection 33, 3 (2018), p. 286-292, https://doi.org/10.2298/NTRP180515011B

Annex I – JRP protocol

Version Date: 28 September 2020

SRT-i22 “EMIRA”

Enhanced Metrology for
Innovative RAdon measurement and management

Partnership
Potential Research Topic

Studying temporal uncertainty for enhanced radon metrology towards large-scale measurements ambition providing a toxic-free indoor environment

Dziękuję za uwagę!

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