

research and innovation programme and the EMPIR Participating States





Designing and construction of a new radon calibration facility in Romania

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Introduction

- The implementation of the European Union Council Directive no. 2013/59/EURATOM in 2018, requires facilities to assure reliable and accurate calibration of the instruments measuring the radon concentration in air.
- Romanian national research project "Realisation of a radon chamber – Calibration stand for the equipment used in the measurement of radon and daughter products concentration in air" (CARSTEAM): a radon chamber was designed, constructed and installed at IFIN-HH, in the Radionuclide Metrology Laboratory (LMR), with the participation of the partners from ICSI Rm. Valcea and the University of Bucharest.

 Radon gaseous activity standards to be used with the radon chamber for instruments calibration are prepared at IFIN-HH, based on an original primary activity standardization method developed at LMR







 Participation to the comparison CCRI(II)-K2.Rn-222, in 2015, organized by the International Committee for Weights and Measures – Consultative Committee for Ionizing Radiation – Section II: Measurement of Radionuclides (CIPM-CCRI(II)) validated the primary activity standardization method used in our laboratory and assured the metrological traceability for the radon activity measurements

The design of the Radon Chamber (RC)

- Study of the radon calibration facilities from ENEA-INMRI (Italy) and IRSN (France)
- System for Test Atmospheres with Radon, according to the standard IEC 61577-4:2009 (Radiation Protection Instrumentation – Radon and radon decay product measuring instruments) – Part 4: Equipment for the production of reference atmospheres containing radon isotopes and their decay products

- available place in the radon laboratory of IFIN-HH;
- use of the primary radon standard system, producing radon standard sources;
- technical possibilities and the funding resources of the CARSTEAM project partners.
- *Complementary*: a Monte Carlo computer code was developed at the University of Bucharest, to simulate the measurement of the activity concentrations of the ²²²Rn decay products using air sampling methods.

Main technical requirements of the RC

- radon tight and robust, provided with thermal insulation of the walls and with a smooth internal surface;
- the radon introduced in the tight precinct must be homogeneously distributed in the air volume (fan).

The decision was made to build the radon chamber as a metallic tight precinct, cylindrical shaped with walls made of stainless steel (4 mm thick) and with a door; the inner volume is 1 m³.

- Monitoring & control of the environmental parameters during the instrument calibration procedures (temperature, humidity and pressure): the radon chamber is placed inside a larger, external chamber with thin (1 mm thick) double steel walls containing polyurethane foam in between (thermal insulator of 150 mm thick).
- The external dimensions of the inner chamber are 1200 mm diameter and 1700 mm long.
- The maximum dimensions of the outer chamber are 2400 mm long, 2000 mm wide and about 1800 mm height.



The 3D concept design of the radon calibration facility at IFIN-HH: general view (left) and vertical section (right)

Design Summary

- *the structural system* (inner & outer chambers)
- the radon supply system for instruments calibration (static / dynamic mode)
- the environmental parameters control systems
- system for data transmission and automated data processing
- electrical power supply system (220 V)

The container for radon transport and transfer (radon vial inside) – static mode (left) and radon input in dynamic mode (right)



Radon chamber construction

- Most of the components (including the tight calibration chamber) built at ICSI Rm. Valcea
- Several design modifications implemented, e.g. the frames for the doors of the external chamber are no longer circular, but made of several linear segments welded

- Electrical power supply for several measurement instruments;
- Data signals transferred to the PC: 6 air tight serial connectors RS232.
- Two small fans are used to homogenize the radon.
- The inner chamber was thermally insulated with material Elastopor[®] H1723/3/35: density 45.2 kg/m³, compressive strength 0.25 MPa, thermal conductivity 0.0244 Wm⁻¹K⁻¹; between -50 °C and +100 °C.
- Input and output steel pipes open/closed by electrical valves introduce pressurized air of high purity (99.99%), respectively evacuate the mixture of air with radon and its daughters in the building special ventilation system.



2014









5th European IRPA Congress, 4-8 June 2018, The Hague, The Netherlands

2016 - 2017





5th European IRPA Congress, 4-8 June 2018, The Hague, The Netherlands 16/25

In development

- IFIN-HH/LMR is accredited by the Romanian Accreditation Association (RENAR) as a calibration laboratory, standard ISO 17025:2005
- New calibration procedures for instruments measuring radon concentration in air → accreditation extension ISO 17025:2017.

PARTICIPATION TO AN EUROPEAN RESEARCH PROJECT



- Horizon 2020 EURAMET EMPIR joint research project:
 "Metrology for radon monitoring" (16ENV10 MetroRADON),
 2017-2020, <u>http://metroradon.eu/</u>.
- •The main objective: to enable radon monitoring, traceable to the International System of Units (SI), at low radon activity concentrations (development of new radioactive reference sources, equipment calibration, radon mapping and criteria necessary to identify the radon priority areas).



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• IFIN-HH/LMR participates mainly in: **WP1** -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 $\leq 5 \%$ (k = 1) and WP5 -Validation of traceability of European radon calibration facilities.



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 WP5, Task 5.2: "Validation of the traceability," performance and precision of European radon calibration facilities in the range from 300 Bq/m³ to 10000 Bq/m³", will confirm and validate the international traceability for the instruments calibrations performed using the new radon chamber [international comparison - successive calibration of the same reference instrument (radon monitor AlphaGUARD Type PQ 2000 PRO TTL) by all the participant partners]



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• WP1, Task 1.2: "Comparison of existing radon gas primary standards at European National **Metrology Institutes/Designated Institutes** (NMIs/DIs) in the few kBq range", IFIN-HH will participate in two CCRI(II) comparisons, in order to compare the results of ²²²Rn (radon) and ²²⁰Rn (thoron) measurements made using the existing radon gas primary standards at different European NMIs/DIs.

CONCLUSION

 A new radon calibration facility was designed and constructed at IFIN-HH, Romania, in order to assure international and national metrological traceability for the measurements of ²²²Rn activity concentration in air.

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Landscape in Netherlands



Landscape in Danube Delta, Romania

THANK YOU! DANK JE! MERCI! GRAZIE! MULTUMESC!