



16ENV10 MetroRADON

Activity 6.3.2

Network of European calibration laboratories for radon concentration in air measurement

Czech Metrology Institute (CMI)

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Introduction

In the framework of the EMPIR Project 16ENV10 Metrology for radon monitoring (MetroRADON), an interlaboratory comparisons were initiated in order to validate the traceability of European radon calibration facilities and to demonstrate their performance in calibrating radon measuring instruments in the ranges from 300 Bq.m⁻³ to 10 000 Bq.m⁻³ (coordinator BfS) and 100 Bq.m⁻³ to 300 Bq.m⁻³ (coordinator SUJCHBO). Calibration services from different EU member states, which preferably represent the respective national reference for the quantity “radon activity concentration in air”, were encouraged to participate in the comparison. The objective of the inter-laboratory comparisons was to determine the degree of agreement in the realization of the activity concentration of ²²²Rn in air in the facilities of the participating laboratories and to create links between selected laboratories. The traceability chains of the quantity “radon activity concentration” in Europe were outlined.

Traceability chain before inter-laboratory comparisons

The participants were requested to provide information on how the traceability of the radon activity concentration is realized. From this information the chart in *Figure 1* was developed, which shows the status of the traceability at the start of the inter-laboratory comparisons in 2018. There are three main branches through which the quantity activity is traced back. The roots of the branches are the national metrological institutes PTB (Germany), LNHB (France) and NIST (USA), which hold the primary quantities. The combined quantity “radon activity concentration” is realized in secondary reference facilities operating at PTB (Germany), BfS (Germany), IRSN (France) and ENEA (Italy).

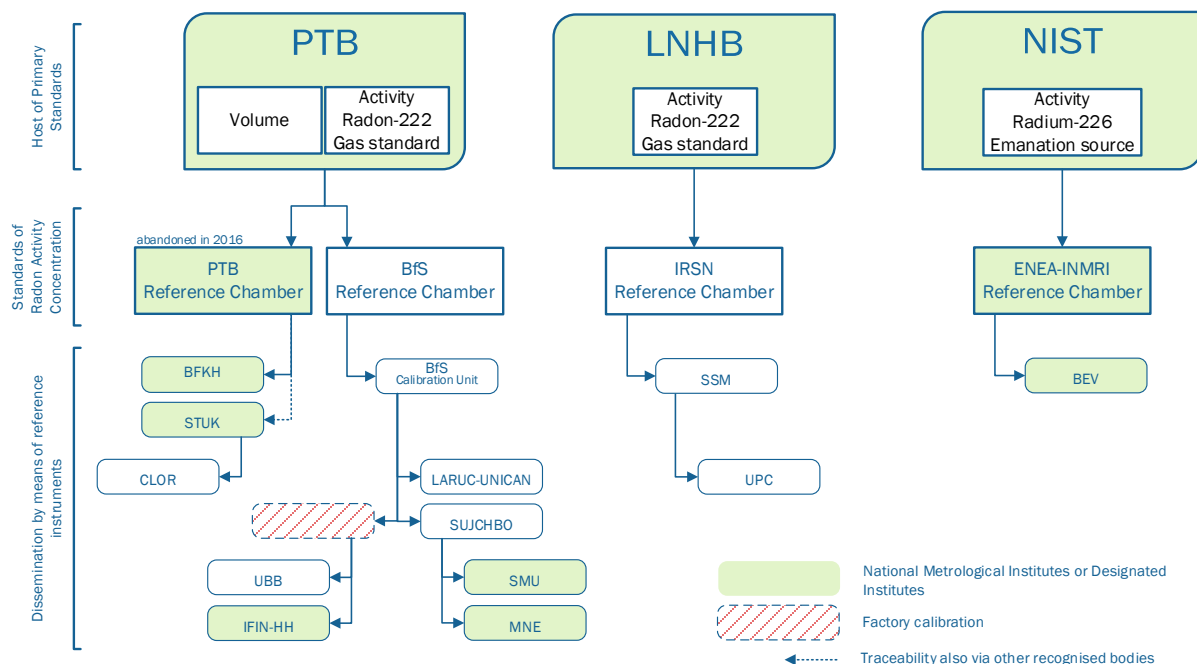


Figure 1 - Chart of traceability of European calibration facilities for radon, status at the start of the inter-laboratory comparison (2018)

It should be noted that PTB has abandoned its reference chamber in 2016. Facilities, which had used the PTB reference chamber to ensure the traceability, will have to undertake a rearrangement after the validity of the traceability has expired. Since 2020, the reference chamber of the BfS has changed the traceability of the quantity activity to LNHB by means of a gas standard.

Network of European calibration laboratories based on validations performed in MetroRADON project

In total 15 calibration facilities from 12 different countries of the European Union and one from Montenegro (MNE) participated in the inter-laboratory comparison in the range from 300 Bq.m^{-3} to $10\,000 \text{ Bq.m}^{-3}$. The inter-laboratory comparison was conducted by the German Federal Office for Radiation Protection (BfS) and took place in the period from March 2018 (first participant) to February 2020 (last participant).

Another verification of secondary standards of European calibration laboratories was performed by SÚJCHBO, v.v.i. Kamenna at stable radon atmospheres in the range from 100 Bq.m^{-3} to 300 Bq.m^{-3} from October 2019 to April 2020. Eight European laboratories have participated in the inter-comparison of secondary standards and nine measuring devices were calibrated.

The considerable number of participants from various European countries with different positions in the metrological hierarchy and thus different positions in the traceability chain of the considered quantity allowed

a representative validation of the performance and quality in the calibration of radon measuring devices. *Table 1* collocates the calibration facilities involved in both comparisons and *Figure 2* shows participating states.

Table 1 - Calibration facilities participating in inter-laboratory comparisons (violet background – laboratory participating only in comparison performed by BfS, orange background – laboratory participating in comparisons at BfS and SUJCHBO)

Short Name	Institute and Address	Country
BEV-PTP	BEV-PTB, Physikalisch-technischer Prüfdienst, Bundesamt für Eich- und Vermessungswesen Arltgasse 35, 1160 Wien	Austria
SUJCHBO (Coordinator)	Státní ústav jaderné, chemické a biologické ochrany Kamenna 71, 262 31 Milin	Czech Republic
STUK	Radiation and Nuclear Safety Authority Laippatie 4, 00880 Helsinki	Finland
IRSN	Institut de Radioprotection et de Sûreté Nucléaire 31 avenue de la division Leclerc, 92262 Fontenay-aux-Roses	France
BfS (Coordinator)	German Federal Office for Radiation Protection Köpenicker Allee 120 – 130, 10318 Berlin	Germany
BFKH	Budapest Főváros Kormányhivatala Németvölgyi út 37-39, 1024 Budapest	Hungary
ENEA	CRE ENEA Casaccia via Anguillarese, 123 - Santa Maria di Galeri, 00123 Roma	Italy
MNE	Bureau of Metrology Arsenija Boljevića bb, 81000 Podgorica	Montenegro
CLOR	Central Laboratory for Radiological Protection Konwaliowa 7, PL 03-194 Warsaw	Poland
IFIN-HH	Institutul National de Cercetare-Dezvoltare pentru Fizica si Inginerie Nucleara "Horia Hulubei" 30 Reactorului St., 077125 Magurele, Ilfov County, POB MG-6	Romania
UBB	"CONSTANTIN COSMA" RADON LABORATORY, Babes – Bolyai University, Faculty of Environmental Science and Engineering Fantanele 30, 400294 Cluj-Napoca	Romania
SMU	Slovak Institute of Metrology, Dept. of Ionizing Radiation Karloveská 63, 842 55 Bratislava	Slovak Republic
LARUC-UNICAN	Radon Group, Laboratory of Environmental Radioactivity of the University of Cantabria (LARUC) C/ Cardenal Herrera Oria S/N, 39011 Santander, Cantabria	Spain
UPC	Laboratory of 222Rn studies (LER) of the Institut de Tècniques Energètiques (INTE) of the Universitat Politècnica de Catalunya (UPC), Campus Diagonal Sud, Edificio PC (Pavelló C) Av. Diagonal, 647, 08028 Barcelona	Spain
SSM	Strålsäkerhetsmyndigheten (Swedish Radiation Safety Authority), Mätning av joniserande strålning (Radiation Measurements) Solna strandväg 96, SE-171 16 Stockholm	Sweden

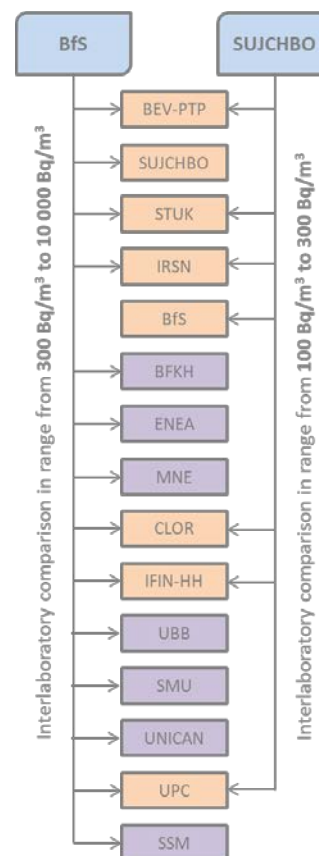
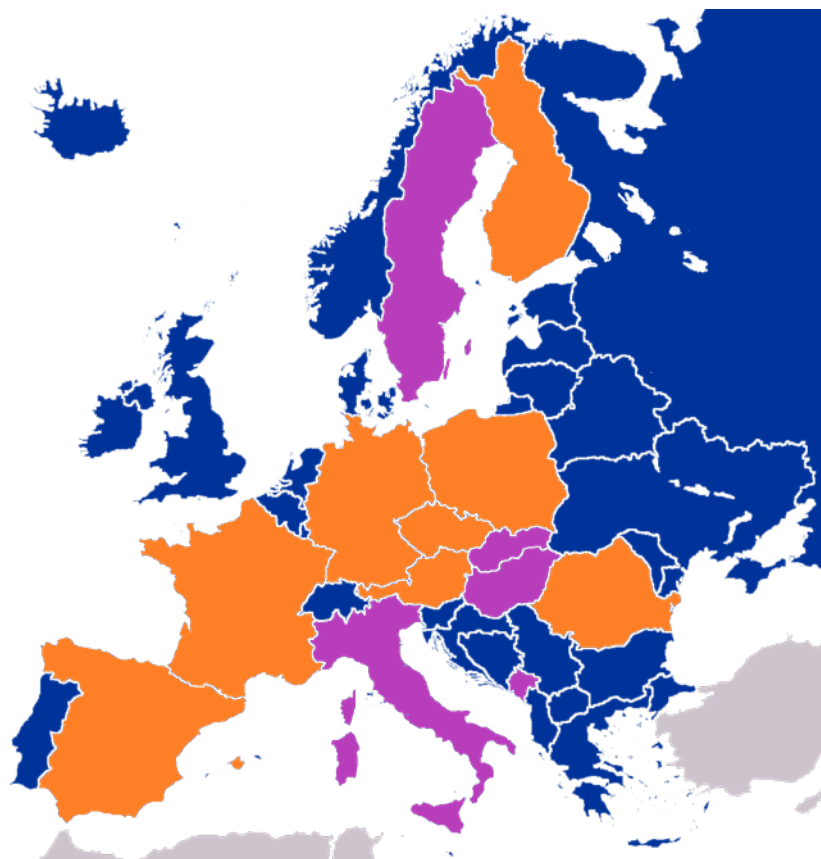


Figure 2 - Map of states involved in inter-laboratory comparisons (violet background – laboratory participating only in comparison performed by BfS, orange background – laboratory participating in comparisons at BfS and SUJCHBO)

Reference laboratories and contacts

BfS

BfS is a higher federal authority in the portfolio of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). BfS has the aim to pool competences in the fields of radiation protection, nuclear safety, transport and storage of nuclear fuels, and radioactive waste disposal. BfS is involved in the implementation of the Council Directive 2013/59/Euratom into national legislation and is developing methods to identify radon priority areas. BfS maintains a calibration service laboratory accredited for the measuring quantities "activity concentration of ^{222}Rn in air" and "potential alpha energy concentration" (PAEC) of the short-lived ^{222}Rn progenies.

BfS (reference laboratory for the comparison in the ranges from $300 \text{ Bq}\cdot\text{m}^{-3}$ to $10\,000 \text{ Bq}\cdot\text{m}^{-3}$) selected an electronic instrument of the type AlphaGUARD as a comparison device for the verification. The device was sent to each participant. The participants had to expose the comparison device at three different levels of radon activity concentration: $400 \text{ Bq}\cdot\text{m}^{-3}$, $1\,000 \text{ Bq}\cdot\text{m}^{-3}$ and $6\,000 \text{ Bq}\cdot\text{m}^{-3}$.

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SUJCHBO

SÚJCHBO is the Czech National Institute for Nuclear, Chemical, and Biological Protection with responsibility for the development and research in the field of chemical, biological and radioactive agents. One of laboratories is engaged in the measurement and the evaluation of natural radioactivity with a special concern for the

measurement of radon and its decay products. Such laboratories had a long tradition, starting in 1954. The Authorized Metrological Centre (AMS) is the only laboratory in the Czech Republic for calibration and testing of the instruments that measure the radon air concentration and the energy equivalent radon concentration connected with the radon decay products. Radon Measurement Laboratory is a division of the Nuclear Protection Department.

To verify the secondary standards of European calibration laboratories, which are used for the calibration of end-user devices, SUJCHBO was selected as reference laboratory. As part of the WP1 task, SUJCHBO in cooperation with the Czech Metrology Institute, Prague (CMI) have developed a device for the calibration of measuring devices at low-level radon activity concentrations (Low-Level Radon Chamber, LLRCH). The equipment consists of a radon chamber LLRCH (Low-Level Radon Chamber) with a volume of 324 liters, a flow-through source of radon with an activity of 4 955 Bq, a calibrated mass flow controller type Bronkhorst EL-Flow and a humidifier. The equipment meets the condition of relative uncertainty less than 5 % ($k = 1$) for calibration of measuring instruments at low-level radon activity concentrations (100 Bq.m⁻³ to 300 Bq.m⁻³).

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Other laboratories and contacts

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CMI

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STUK

www.stuk.fi

IRSN

www.irsn.fr

BFKH

www.mkeh.gov.hu

ENEA

www.enea.it

MNE

www.metrologija.me

CLOR

www.clor.waw.pl

IFIN-HH

www.nipne.ro

UBB

www.ubbcluj.ro

SMU

www.smu.gov.sk

LARUC-UNICAN

www.web.unican.es

UPC

www.inte.upc.edu

SSM

www.stralsakerhetsmyndigheten.se