The Radon Calibration Laboratory at the Federal Office for Radiation Protection (BfS)

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Bundesamt für Strahlenschutz (Federal Office for Radiation Protection)

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International Intercomparison Exercise on Natural Radiation Measurements under Field Conditions

LaRUC, 23-27 May 2011

Functions and objectives

- **Coordinating office for the surveillance of elevated natural radioactivity**
- **Determination of radiation exposures resulting from radon and radon progenies**
- **Recognized metrological reference laboratory for radon-222 and short-lived radon progenies (secondary standard)**
- **Quality assurance for the measurement of radon and radon progenies in Germany**

Program for Quality Assurance

- **Scientific investigations on metrological fundamentals**
- **Evaluation and development of measurement methods**
- **Type testing**
- **Calibration service for measurement devices**
- **Interlaboratory comparisons for passive radon monitors**

Laboratory for Radon-222 activity concentration

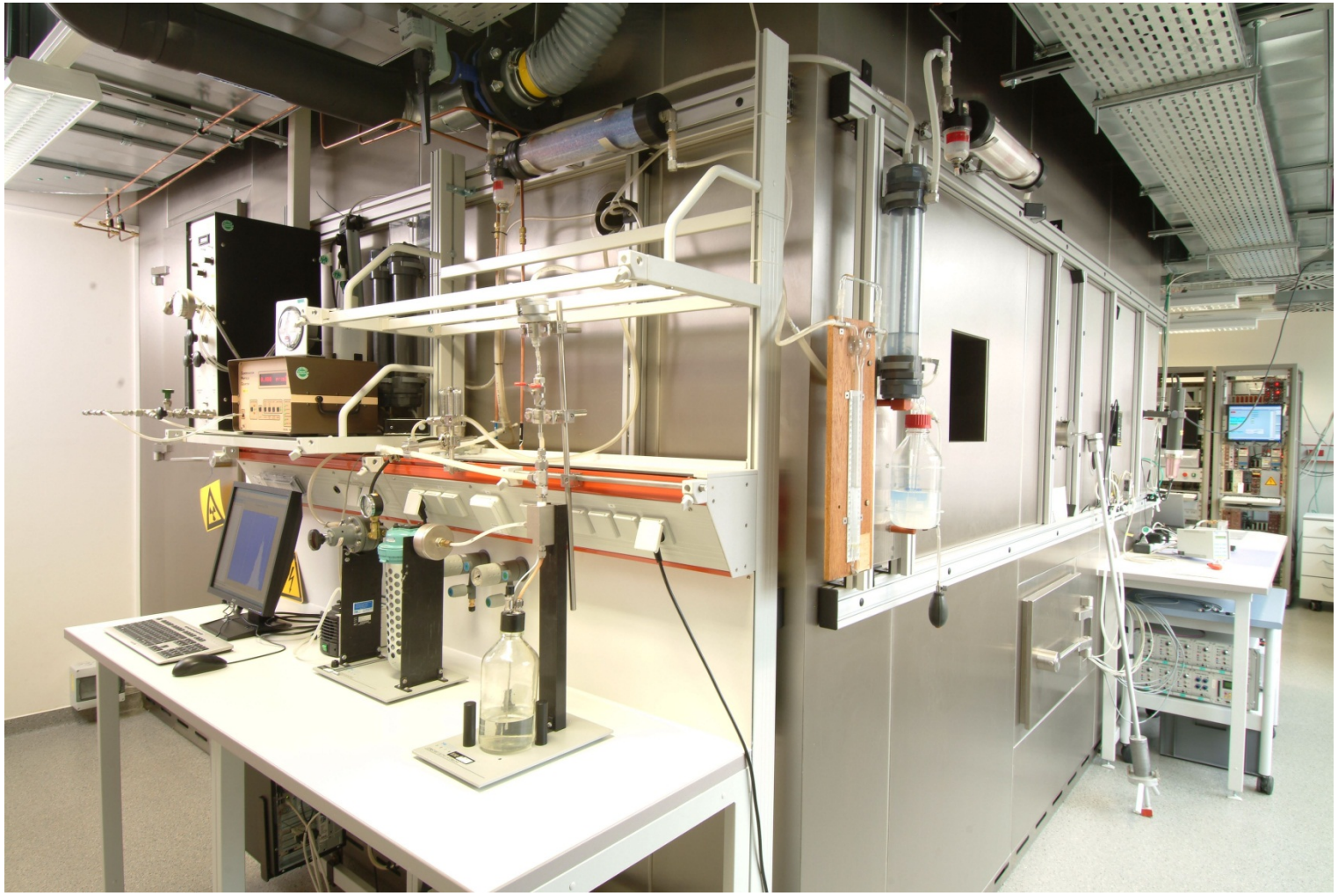
Walk-in radon chamber

(Volume: 11 m³)

Barrels

(Volume: 0.4 m³)

Laboratory for the Potential Alpha-Energy Concentration of the Short-Lived Radon-222 progenies (PAEC)



Walk-in PAEC chamber (volume: 30 m³)

Radon Calibration Laboratory at BfS

DAkkS
Deutsche
Akkreditierungsstelle
D-K-15063-01-00

Accreditation:

by the German accreditation body according to DIN EN ISO/IEC 17025: 2005

Measurands:

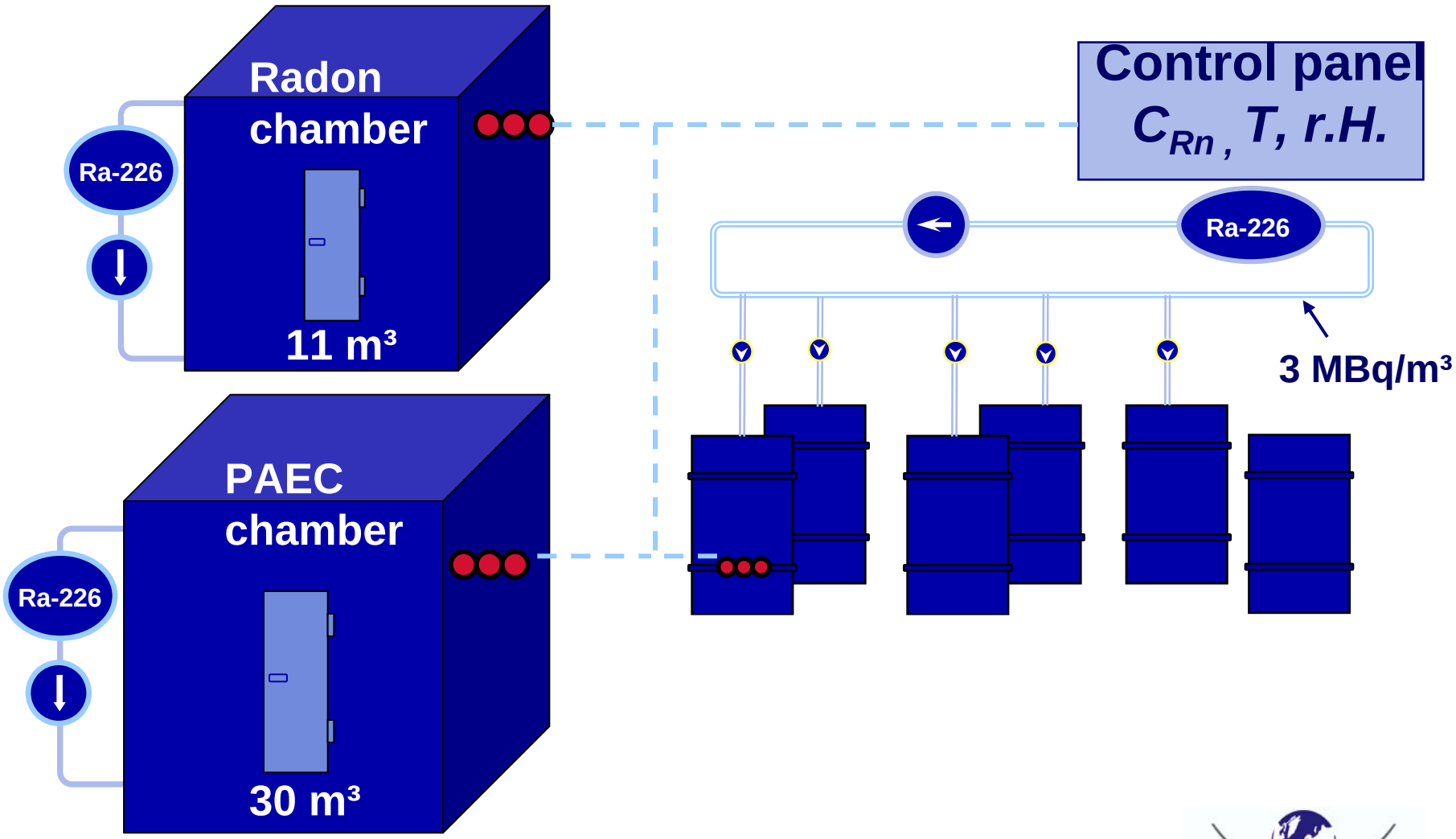
- **Activity concentration of radon-222 in air (C_{Rn})**
- **Potential alpha energy concentration of radon-222 short-lived decay products (C_P *or PAEC*)**

Traceability: to the National Standards at the German National Metrology Institute „Physikalisch-Technische Bundesanstalt“ (PTB)

Technique and equipment

2 chambers

set of 400 l containers



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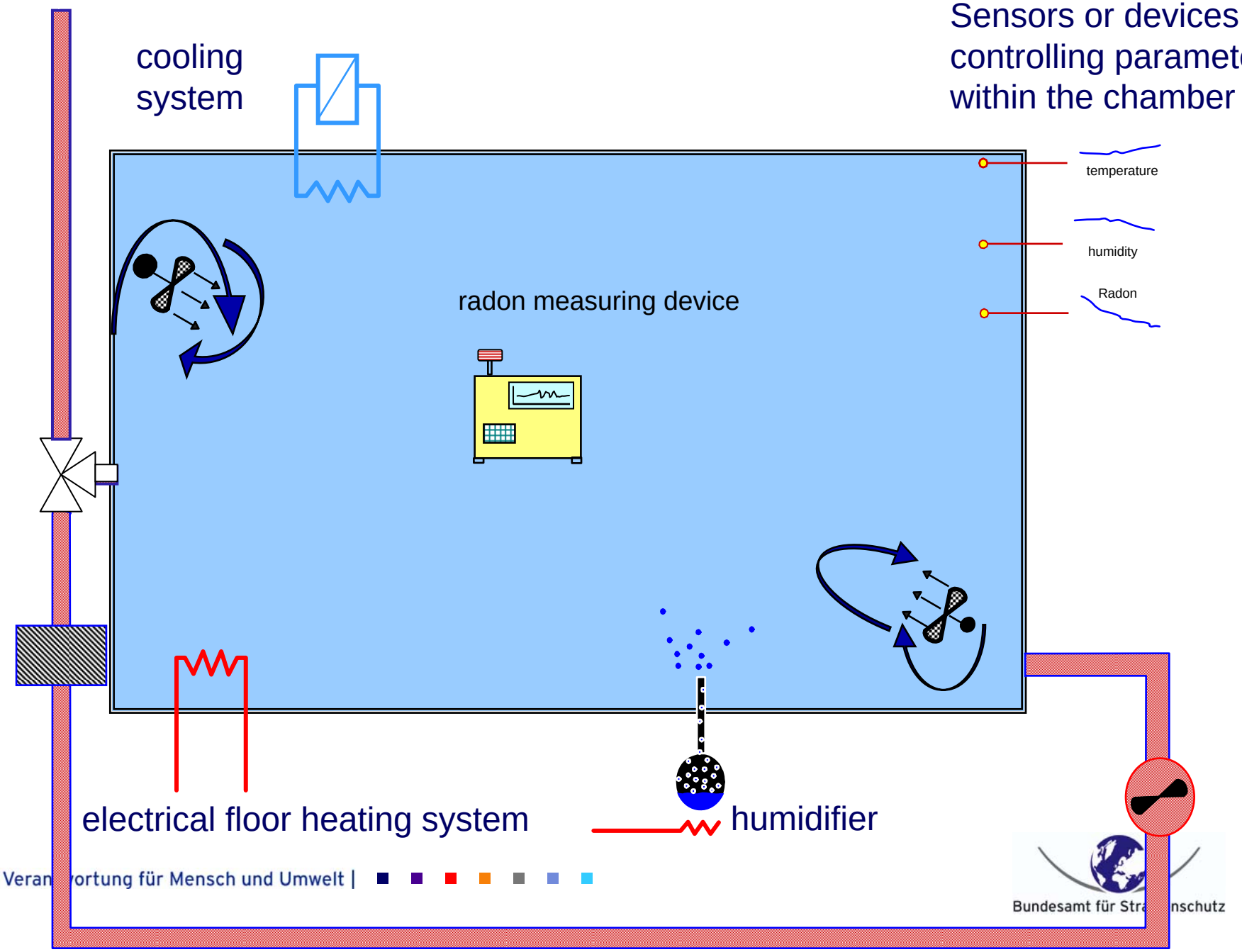
Radon chamber / PAEC chamber



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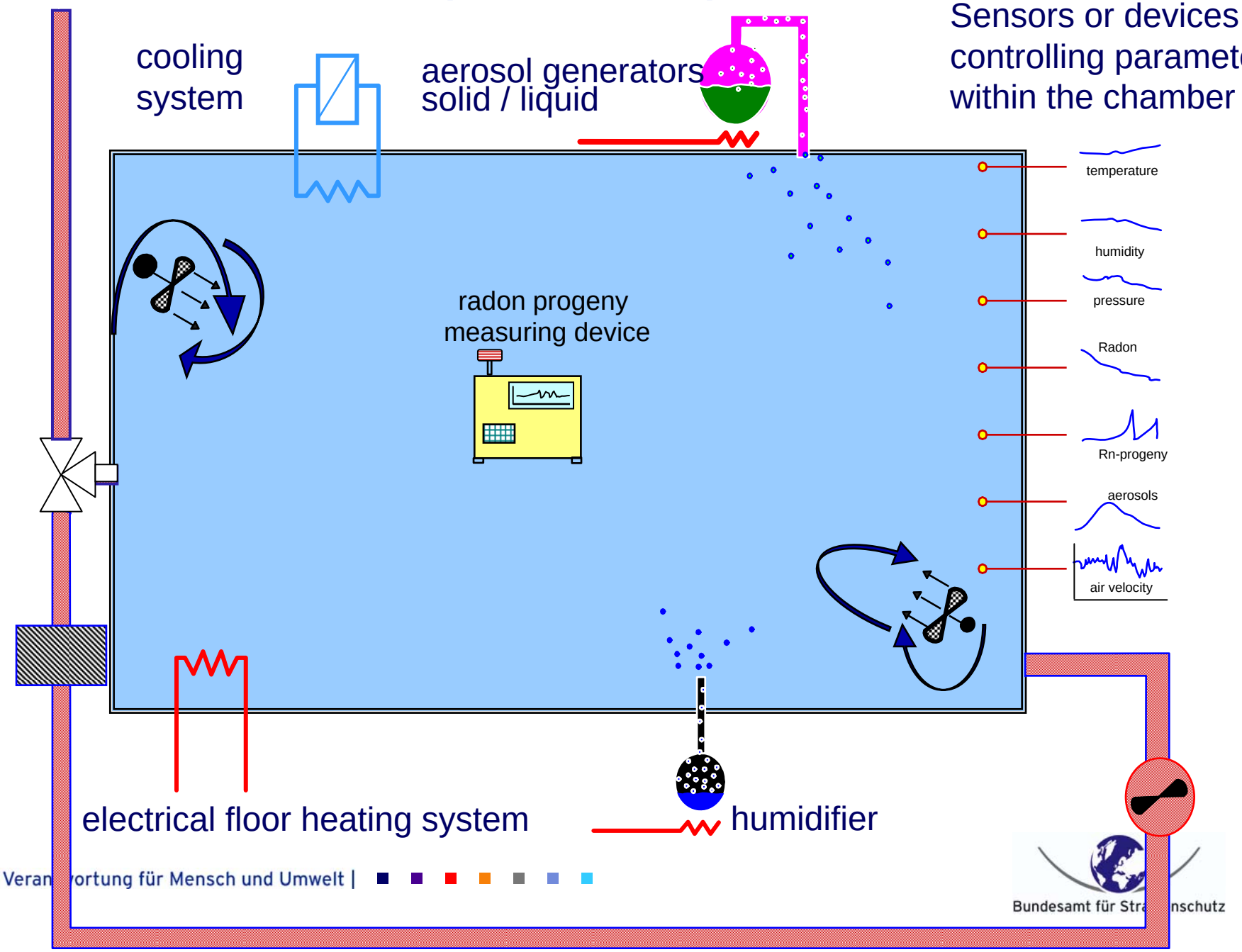
PAEC chamber (volume: 30 m³)



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Measurement parameters and their range of adjustment (Radon chamber)

Measurement parameter	Range of adjustment
Radon-222 activity concentration C_{Rn}	50 … 100 000 Bq/m³
Air temperature	-5 … 50 °C
Relative humidity	10 … 95 %

Measurement parameters and their range of adjustment (PAEC chamber)

Measurement parameter	Range of adjustment
Radon-222 activity concentration C_{Rn}	50 … 100 000 Bq/m³
Air temperature	-5 … 50 °C
Relative humidity	10 … 95 %
Air pressure	Atmospheric pressure (not adjustable)
Potential alpha-energy concentration of the short-lived radon-222 progenies (*PAEC*)	0.3 …640 µJ/m³
Particle concentration of the aerosol	200 … 200 000 particles/cm³
Equilibrium factor	0.1 … 0.9
Unattached fraction of *PAEC*	< 1 … 90 %
Air flow velocity (turbulence)	0 … 1 m/s

Traceability C_{Rn}

Physikalisch-Technische Bundesanstalt (PTB)

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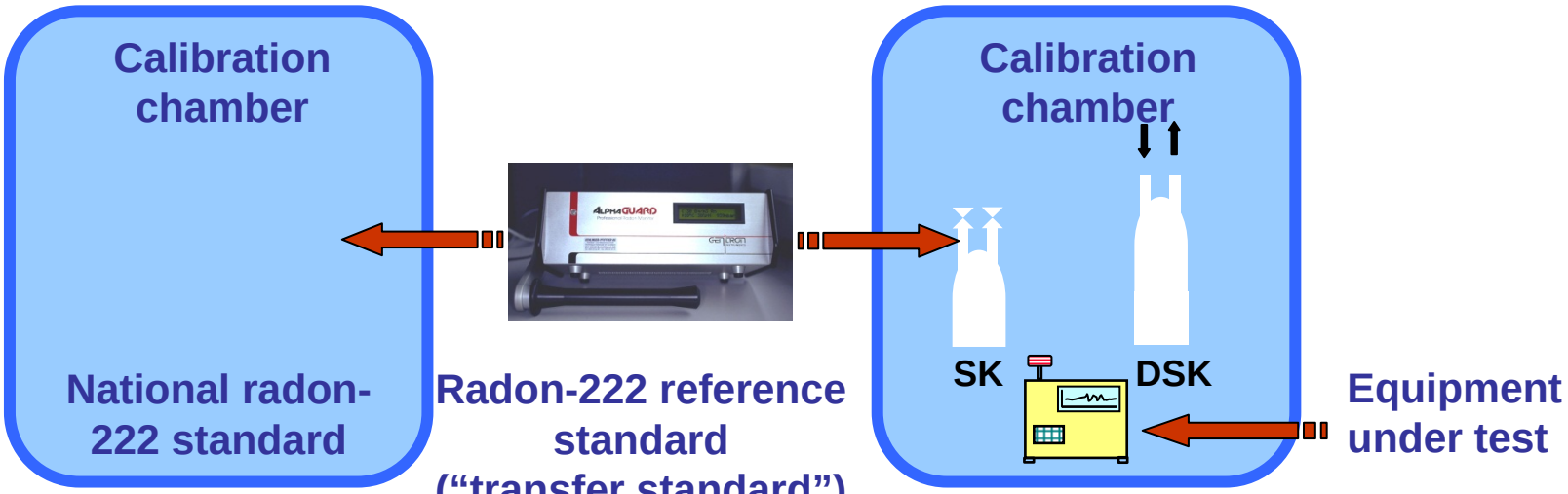


SK : Scintillation chamber
DSK: Flow-thru scintillation chamber

Radon-222 activity concentration: Budget of the measurement uncertainty

	Range of measurand	Best measurement uncertainty of the reference measurement *)
Activity concentration of radon-222 in air	50 Bq/m^3 to 1000 Bq/m^3	12 %
	1000 Bq/m^3 to 10000 Bq/m^3	7 %
	10000 Bq/m^3 to 100000 Bq/m^3	6 %

*) The extended relative measurement uncertainty results from the standard uncertainty of measurement multiplied with a coverage factor k=2. It was determined in accordance with DAkkS-DKD-3“Angabe der Messunsicherheit bei Kalibrierungen”, 2010, Deutsche Akkreditierungsstelle GmbH, Braunschweig (German translation of publication EAL-R2 „Expression of the Uncertainty of Measurement in Calibration“).

Interlaboratory Comparison

Test items:

Passive radon measuring devices using
solid state nuclear track detectors,
electrets or
activated charcoal

Frequency of performance: **Annually since 2003**

Announcement: **http://www.bfs.de**

Participation:

National and international institutions (in order to fulfil the requirement of validation)

Number of devices and groups

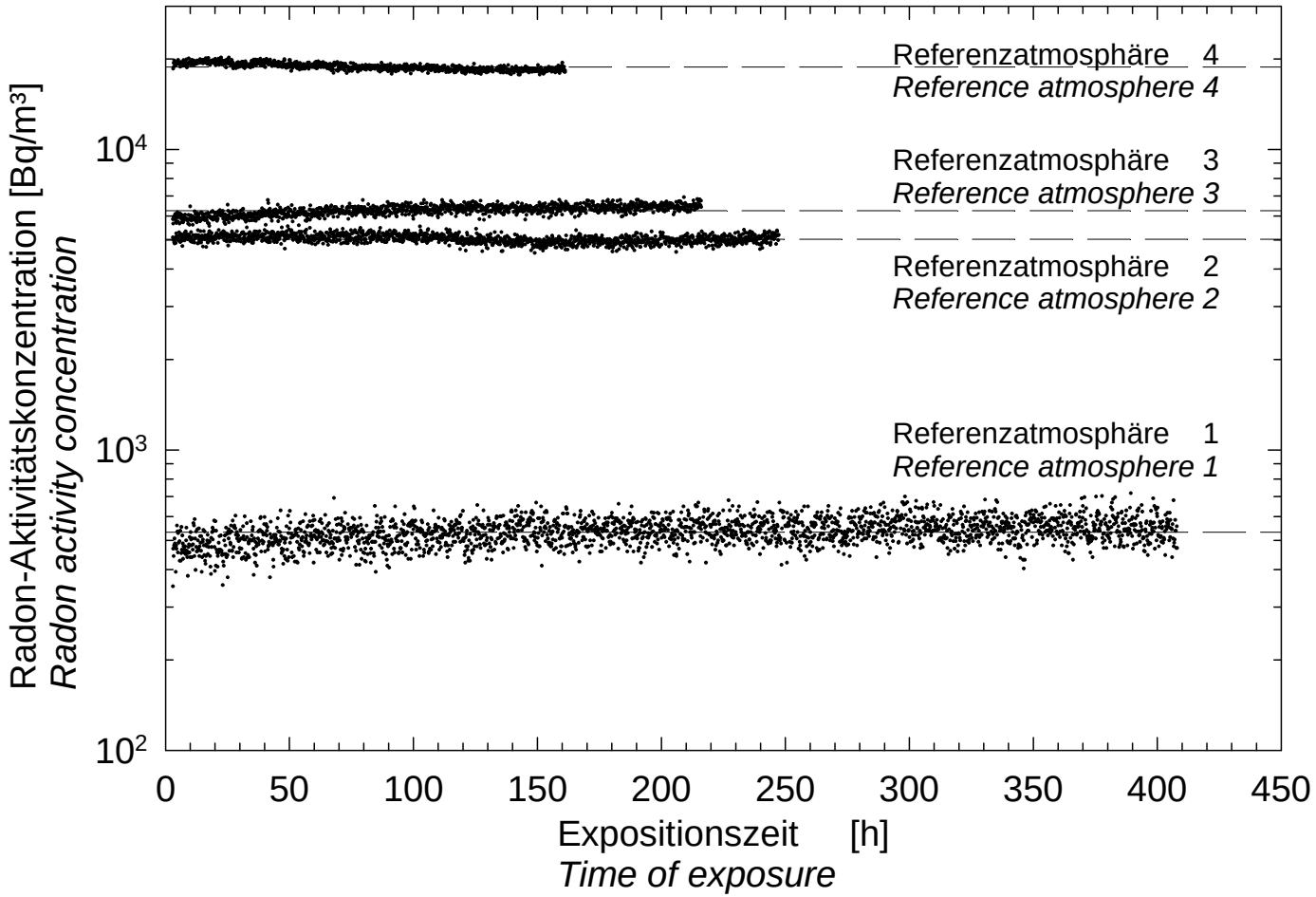
Type of detector	Devices to be submitted	Number of exposure groups	"Transit" group	Exposure duration
SSNTD	35	4	Yes	1 … 3 weeks
Electret	24	3	Yes	1 … 3 weeks
Activated charcoal	8	1	No	48 hours / 72 hours

Exposure data 2010 (SSNTDs, electrets)

No.	t [h]	$C_{Rn,Ref}$ [Bq·m^{-3}]	$P_{Rn,Ref}$ [kBq·h·m^{-3}]	U ($C_{Rn,Ref}$) [%]	r.H. [%]	T [°C]
1	408	439	234	12	20	20.6
2	474	1644	1224	7	13	20.7
3	216	4380	1330	7	10	20.6
4	162	9068	3023	7	21	20.9

U[%]…extended relative uncertainty of $C_{Rn,Ref}$ with coverage factor k=2 (95% confidence level)

Time variation of radon activity concentrations (SSNTDs, electrets)



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Number of participants in 2010: 27

SSNTDs (24 sets)

Electrets (4 sets)

Charcoal detectors (6 sets)

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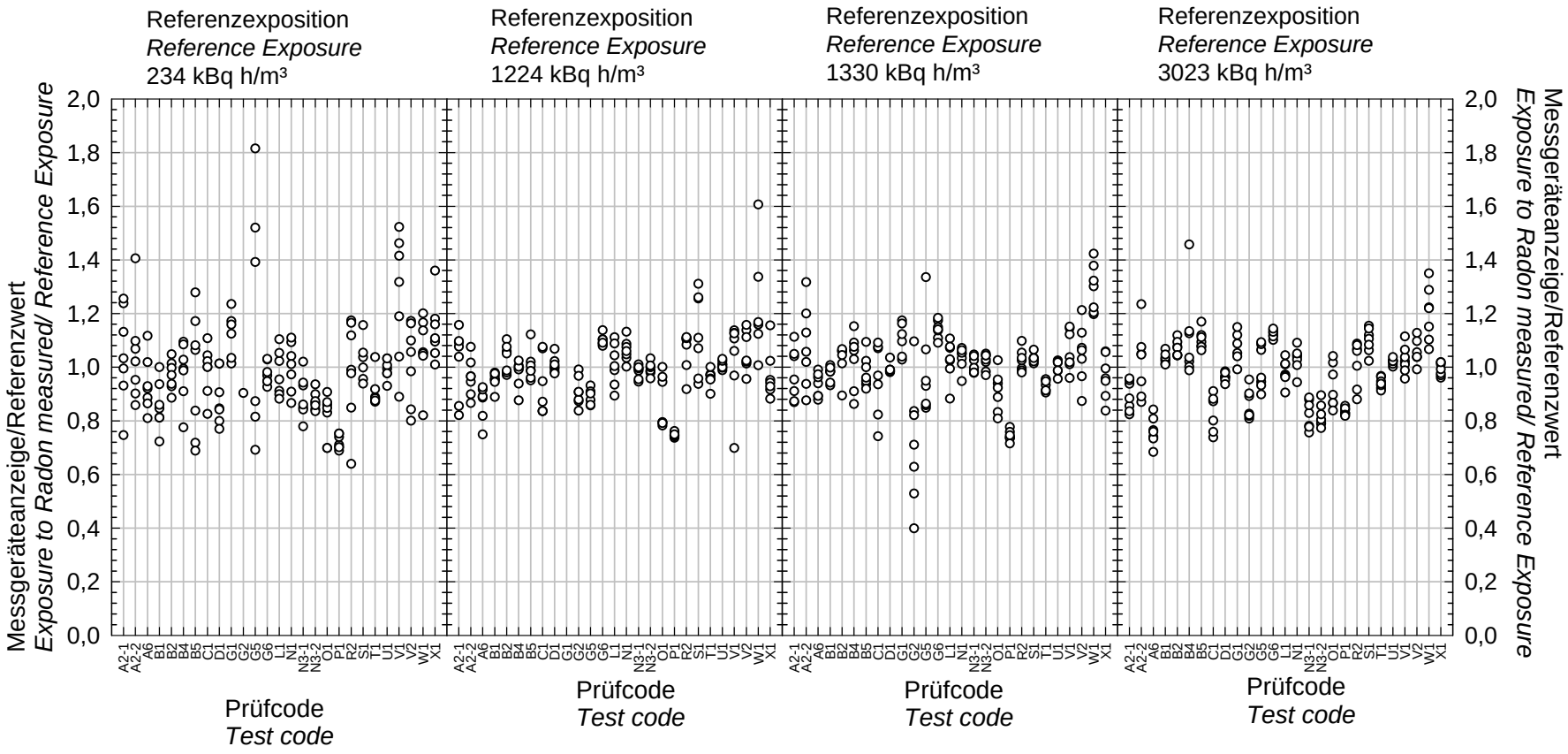
Interlaboratory Comparison 2010
Relative Error (SSNTDs, electrets)



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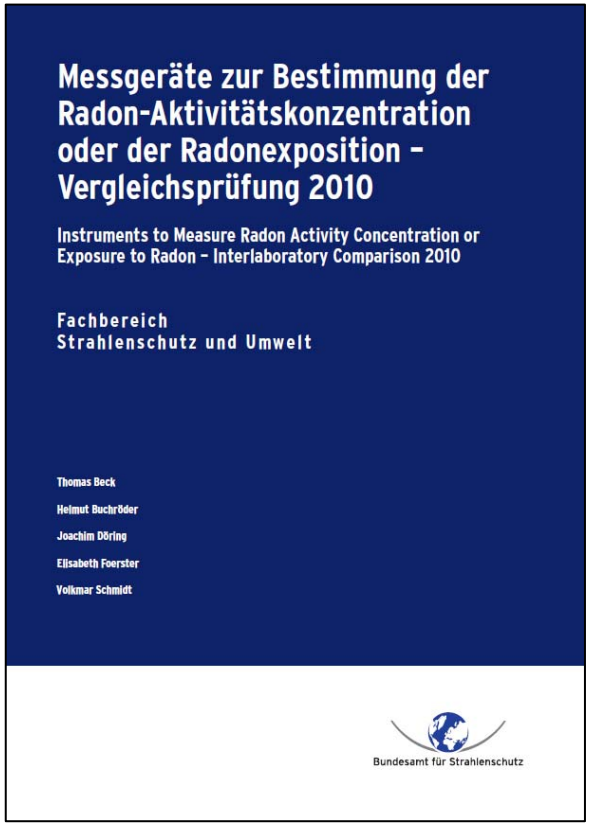
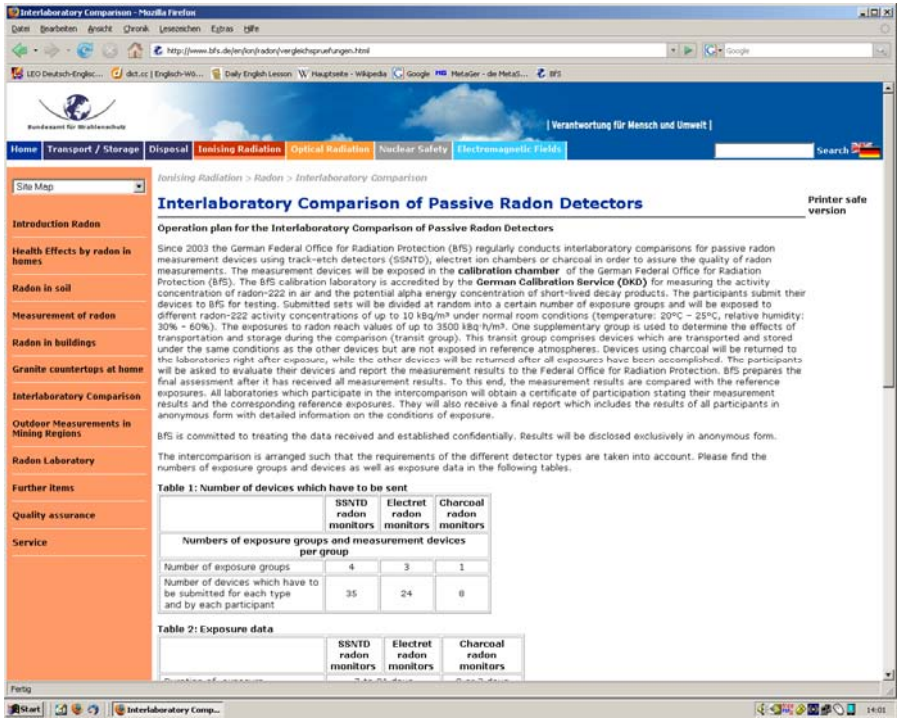
Interlaboratory Comparison of Passive radon detectors at BfS





urn: nbn:de:0221-201008113016

http://www.bfs.de/de/ion/radon/fachinfo_messung/vergleichspruefungen.html

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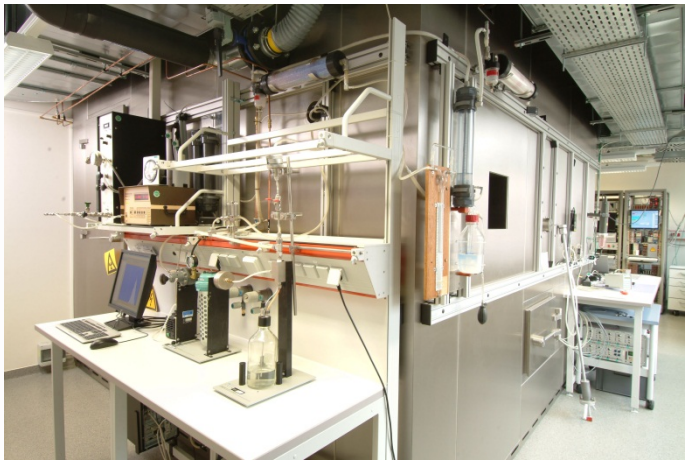

http://www.bfs.de/de/ion/radon/labor.html