Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

NINTH INTERNATIONAL
CONFERENCE ON RADIATION
IN VARIOUS FIELDS OF RESEARCH
June 14-18, 2021 | Hunguest Hotel Sun Resort | Herceg Novi | Montenegro

support BSS

EURAMET

Support for a European Metrology Network on reliable radiation protection: Gaps in radiation protection metrology

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EMPIR 19NET03 supportBSS:

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EMPIR

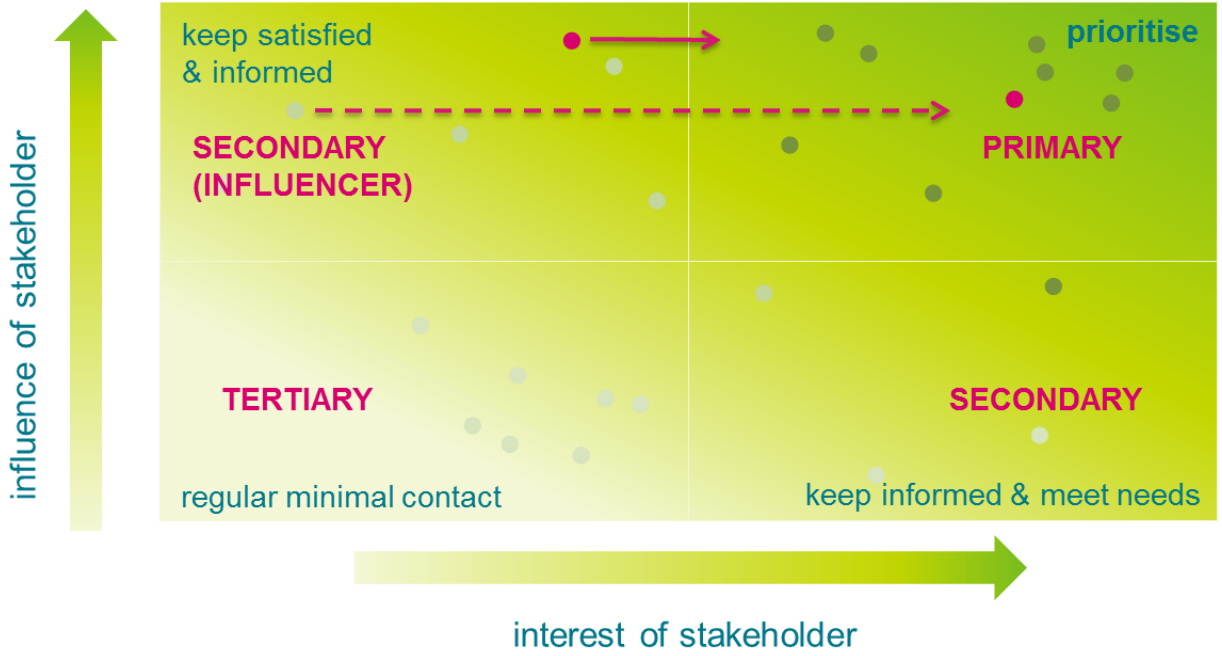
EURAMET

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

EURAMET EMN strategy

- To develop and establish a joint and sustainable European metrology network (EMN) based on stakeholder needs

➢ To meet the metrology needs of stakeholders



Virtual Workshop „Stakeholder mapping“,
Caroline Pritchard, NML at LGC , EURAMET workshop, Jan 2021

19NET03 supportBSS project

- Implementation of the EMN strategy in radiation protection (RP) metrology
  - To meet the metrology needs of ionizing radiation (IR) stakeholders

IR Metrology community

Interactions

IR Stakeholder

WP5 (PTB):
Joint & sustainable European metrology infrastructure

WP1 (IMBiH):
Communication strategy

WP2 (CMI):
Web portal

WP3 (IST):
SRAs & Roadmaps

WP4 (NPL)
Knowledge sharing & capacity building

WP1 (IMBiH):
Identification of the Stakeholder and needs

Gaps in radiation protection metrology

- Virtual Workshop „Gaps in RP metrology“, 11th September 2020
  - ➢ As an interaction between IR metrology and stakeholder communities
  - ➢ As a part of 19NET03 supportBSS project activities
  - ➢ To identify metrological gaps in 8 areas:

1. Activity standards
2. Reference fields
3. New operational quantities in radiation protection
4. Measuring devices for radiation protection in medical or industry applications of IR
5. Measuring devices for environmental monitoring
6. Type testing
7. Harmonized handling, transmission, storage and availability of measurement data
8. Education and training needs

Virtual Workshop on
Gaps in radiation protection metrology
11 September 2020

TOP 1: reference fields
TOP 2: radiation protection quantities
TOP 3: education and training needs
TOP 4: measurement devices for radiation protection in medical or industry applications of ionizing radiation or for environmental monitoring & handling and transmission of measurement data
TOP 5: activity standards
TOP 6: type testing: harmonisation and national requirements & radiation protection legislation, ISO standards, accreditation

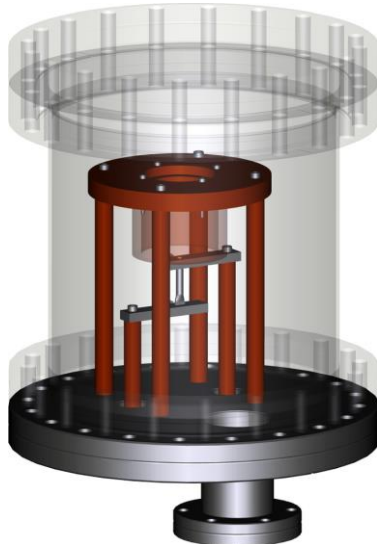
08:30 - 09:00	Technical test of the Web Conference
09:00 - 09:10	**Welcome**
09:10 - 09:30	**Introductory Lecture:** *View of the IAEA*, Paula Toroi (IAEA)
	Impulse Lectures on TOP 1
09:30 - 09:45	*Towards a reference field for pulsed radiation in linac facilities. The role of Monte Carlo calculations*, Liset de la Fuente Rosales (PTB)
09:45 - 10:00	*Neutron Reference Fields*, Vincent Gressier (IRSN)
	Impulse Lecture on TOP 2
10:00 - 10:10	*ICRP and ICRU proposals for new quantities: A critical review*, Pete Burgess (Radiation Metrology Ltd)
	Impulse Lecture on TOP 3
10:10 - 10:25	*Developing innovative sensors for environmental water monitoring and management*, Paul Leonard (CRA Risk)
10:25 - 10:35	**Break**
	Impulse Lectures on TOP 4
10:35 - 10:45	*Which gaps jeopardise Radon protection? The viewpoint of an authority AND accredited calibration lab,* Sebastian Feige (BfS)
10:45 - 10:55	*A service provider's view*, José-Luis Gutiérrez Villanueva (Radonova)
	Impulse Lecture on TOP 5
10:55 - 11:05	*Activity standards*, Stefan Röttger and Dirk Arnold (PTB)
	Impulse Lectures on TOP 6
11:05 - 11:20	*Conformity assessment between product control and radiological protection*, Takatoshi Hattori (CRIEPI)
11:20 - 11:30	*Standardization in Radiation Protection Dosimetry*, Rolf Behrens (PTB)

Metrology Gaps (area 1): Activity standards

- Gaps arising from European Council Directive 2013/59/EURATOM
  - Lowered limits and reference values:
  - Activity range 100 Bq/m^3 to 300 Bq/m^3 for ^{222}Rn indoor air
  - Activity too low for decaying gas standards
  - Activity range 1 Bq/m^3 to 100 Bq/m^3 for ^{222}Rn outdoor air
  - Needed for radon tracer method in climate change observation (green house gas)

  - ^{222}Rn, ^{238}U, ^{234}U, ^{228}Ra, ^{226}Ra, ^{210}Pb, ^{210}Po and ^{3}H in and over drinking water:
  - Radiochemical procedure validation
  - Lack of Certified Reference Materials for environmental samples
  - Traceability for real chemical composition

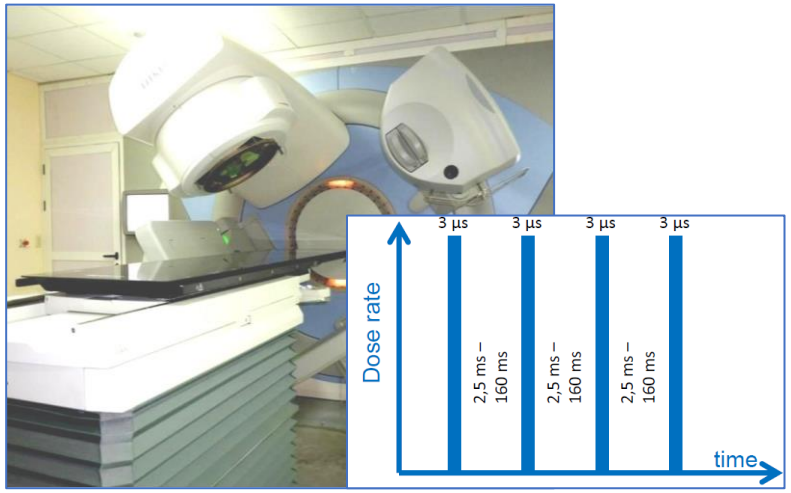
- Gaps in medical field
  - More and complex “new” radionuclides e.g., in nuclear medicine:
  - Short half-life (high activities)
  - Impurities (huge dynamic range GBq to Bq)
  - Nuclear decay data (unknown, at least too large uncertainties)



Virtual Workshop „Gaps in radiation protection metrology“, Dirk Arnold and Stefan Röttger, PTB, Sep 2020

Metrology Gaps (area 2): Reference fields

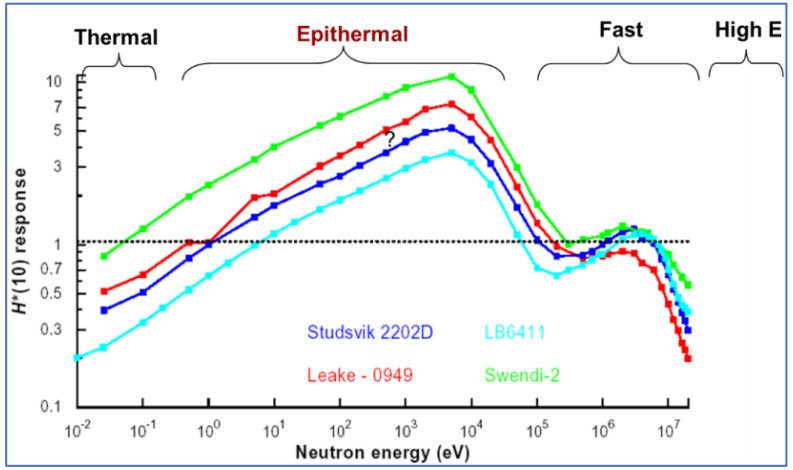
- Photon reference field
  - ➢ Pulsed radiation with pulse durations in μs or shorter and with high dose rate during the radiation pulse
  - ➢ Limitation of calibration fields that represent realistic conditions (pulsed fields, mixed fields, high energy, high dose rate)
  - ➢ Traceable measurements and characterized dosemeters for radiation protection at accelerator facilities (linacs)



Virtual Workshop „Gaps in radiation protection metrology“, Liset de la Fuente, PTB, Sep 2020

- Neutron reference field
  - ➢ Difficulties in neutron dosimetry due to lack of resources to characterize dosemeters in realistic fields
  - ➢ No operating neutron reference field in high (20 MeV - 1 GeV) and epithermal (0.5 eV - 1 keV) energy region
  - ➢ Simulated workplace neutron fields satisfying the requirements of ISO 12789

Virtual Workshop „Gaps in radiation protection metrology“, Vincent Gressier, IRSN, Sep 2020



R. J. Tanner et al. *Neutron area survey instrument measurements in the EVIDOS project*. Radiat. Prot. Dosim. 125, 300–303 (2007)

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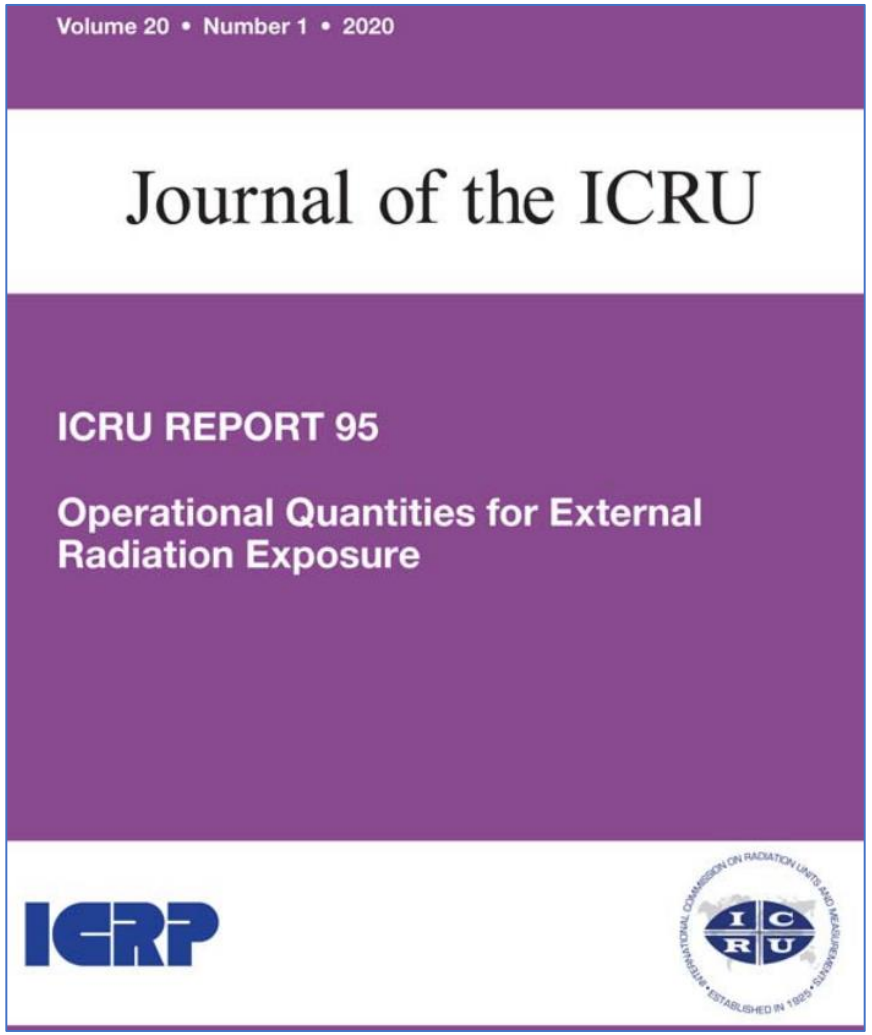
Metrology Gaps (area 3): New operational quantities

- Operational quantities in radiation protection
- ➢ Many instruments are “blind” below 60 keV, but many workplaces in medicine will have lower mean energies
- ➢ Modification of the dosemeters for new quantities
- ➢ Instrument for beta radiation
- ➢ Testing under Non-Charged Particle Equilibrium (Non-CPE)

Virtual Workshop „Gaps in radiation protection metrology“,
Pete Burgess, Radiation Metrology Ltd, Sep 2020

- Risk of leaving a well performing system, without significantly improving radiation safety
- ➢ Impact on instrument design
- ➢ Need of legislative adaptations

Virtual Workshop „Gaps in radiation protection metrology“,
Paula Toroi, STUK, Sep 2020



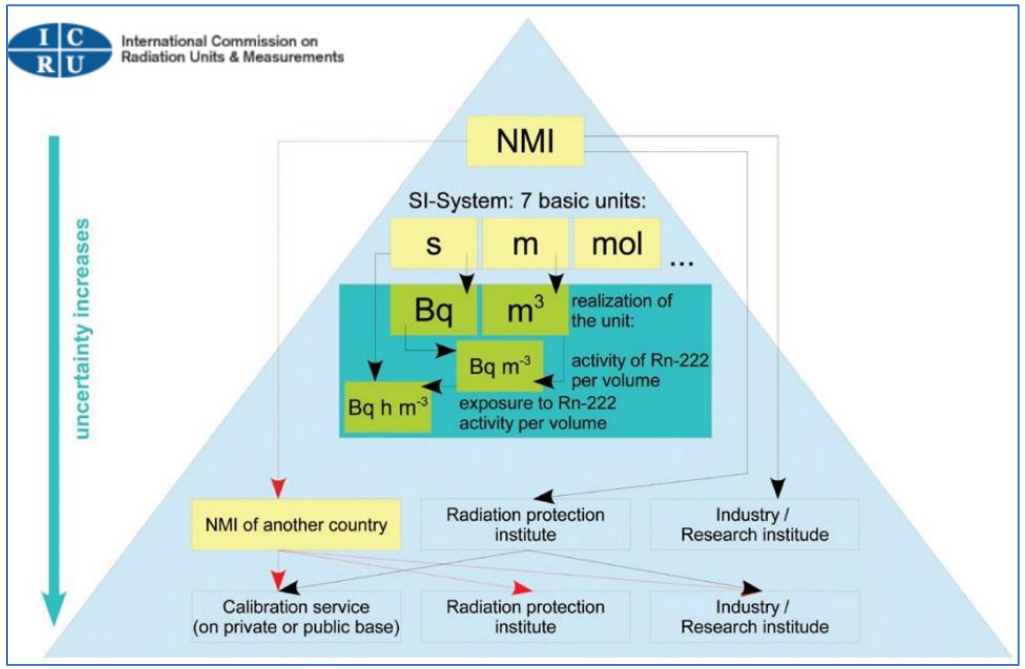
https://www.icrp.org/publication.asp

Metrology Gaps (area 4): Measuring devices (rad. prot.)

- Measuring devices for radiation protection in medical or industry applications of IR
- Pulsed radiation
  - ➢ Development of suitable dose measuring devices for pulsed radiation and for low energies are missing.

- Radon metrology
  - ➢ Limited number of suppliers of primary Radon gas standard: in Europe recently LNHB, METAS, (PTB)
  - ➢ In Europe, only 2 NMIs (Austria, Ukraine) realize the relevant measurand Radon-222 activity concentration in air
  - ➢ Accredited calibration laboratories are suffering intercomparison on a similar metrological level.

- Large variability of equipment a
  - ➢ Need to confirm the minimal requirement (IEC, CE)- Issues related to the definition of “medical device”
  - ➢ Guidance for the end-user



Virtual Workshop „Gaps in radiation protection metrology“, Paula Toroi, STUK, Sep 2020

Virtual Workshop „Gaps in radiation protection metrology“, Sebastian Feige, BfS, Sep 2020

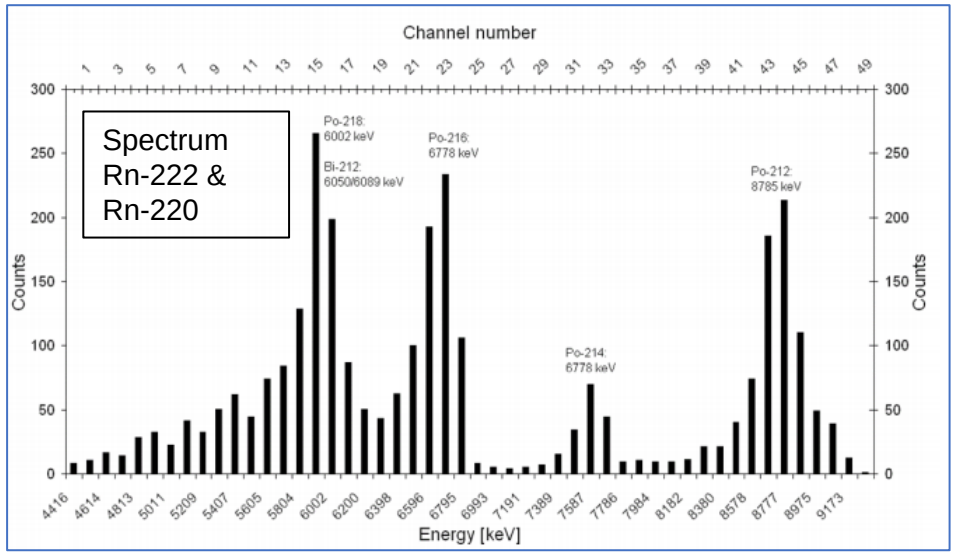
Metrology Gaps (area 5): Measuring devices (environm.)

- Measuring devices for environmental monitoring

- Developing innovative sensors for environmental water monitoring and management
- ➢ Development of environmental sensors often takes years e.g., INTCATCH.

Virtual Workshop „Gaps in radiation protection metrology“, Paul Leonard, CRA, Sep 2020

- Thoron (Rn-220) - underestimated in the big shadow of Radon?
- ➢ COUNCIL DIRECTIVE 2013/59/EURATOM: indoor exposure to radon and thoron, in workplaces, dwellings and other buildings
- ➢ No NMI realizes the measurands radon-220 activity concentration in air or potential alpha energy-concentration of radon-progenies
- ➢ A traceability for a Thoron progeny atmosphere is yet not available (Experiences PTB, some recent activity at BfS and in frame of RadoNorm-Project)



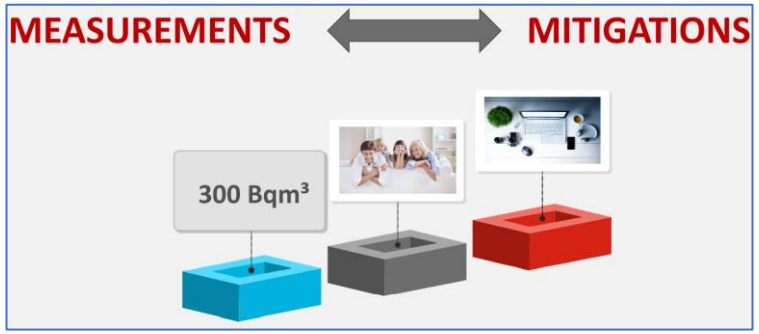
Virtual Workshop „Gaps in radiation protection metrology“, Sebastian Feige, BfS, Sep 2020

Metrology Gaps (area 6): Type testing

- Type testing: harmonization of national requirements with international standards (IEC and ISO) and radiation protection legislation

- Radon in regulation
  - ➢ Risk evaluation
  - ➢ Missing of mitigation standards
  - ➢ Different conversion for works and public
  - ➢ Different radon awareness
  - ➢ Missing of standards for radon in soil activity concentration and radon exhalation rate

- Should a metrological control be required for the approval of radon instruments (type test)?
  - ➢ No technical infrastructure (independent inspection bodies) exist for carrying out type tests specified in IEC 61577
  - ➢ No measurement instruments on the market available, which fulfill these requirements



Virtual Workshop „Gaps in radiation protection metrology“, José - Luis Gútierrez Villanueva, radonova, Sep 2020

Test parameter of IEC 61577 (Selection):

Influence quantities: temperature, humidity, air pressure
Linearity and repeatability
Mechanic stability
Electromagnetic compatibility (not yet included in IEC 61577)
Power supply and battery
Software, data storage and presentation of result

Virtual Workshop „Gaps in radiation protection metrology“, Sebastian Feige, BfS, Sep 2020

Metrology Gaps (area 6): Type testing

- Type testing: harmonization of national requirements with international standards (IEC and ISO) and radiation protection legislation

- ICRP and ICRU proposals for new operational quantities
  - ➢ Significant changes in nearly all related standards needed!

- The contribution is the most influential at the international level
  - ➢ Adoption as EN and national standards

- Standards for similar measuring tasks contain extremely different requirements
  - ➢ Harmonization needed!

PTB Standards for dosemeters and dosim. systems

		Photons	Betas	Neutrons
Area dosemeters	Active	IEC 60846-1:2009 portable $H'(0.07)$, $H^*(10)$ IEC 60846-2:2015 portable, emergency $H'(3)$ IEC 61017:2016 environm. monitoring $H^*(10)$ IEC 60532:2010 fixed inst. in NPPs **Harmonization needed!**	**Harmonization needed!**	IEC 61005:2014 rate meters **Harmonization needed!** IEC 61322:2020 fixed installed
	Passive dosim. systems	IEC 62387:2020 all detector types	$H'(0.07)$, $H'(3)$, $H^*(10)$	**Still missing!**
Personal dosemeters	Active	**Revision started**	IEC 61526:2010 all detector types $H_p(0.07)$, $H_p(10)$ $H_p(3)$	
	Passive dosim. systems	IEC 62387:2020 all detector types $H_p(0.07)$, $H_p(3)$, $H_p(10)$		ISO 21909-1:2015 all detector types $H_p(10)$ ISO 21909-2, DIS 2020 dosemeters for special workplaces (e.g. Albedo)

Virtual Workshop „Gaps in radiation protection metrology“, Rolf Behrens, PTB, Sep 2020

Metrology Gaps (area 7): Measurement data

- Harmonized handling, transmission, storage and availability of measurement data

- Emergency response
  - ➢ Data management: How to manage big data, artificial intelligence? There is no training or tools for that! Is it possible to map for food, environment and water the pollution?
  - ➢ Environmental transfer processes are important in emergency situations. Here there is a large research need (e.g., short term exchange from earth to sea, but also realistic as well as reliable K_D-values for modelling long-term radioecological behaviour).

Virtual Workshop „Gaps in radiation protection metrology“,
Paul Leonard, CRA, Sep 2020

- Radon metrology
  - ➢ No qualified central information platform on radiation protection institutes and calibration services with their capabilities

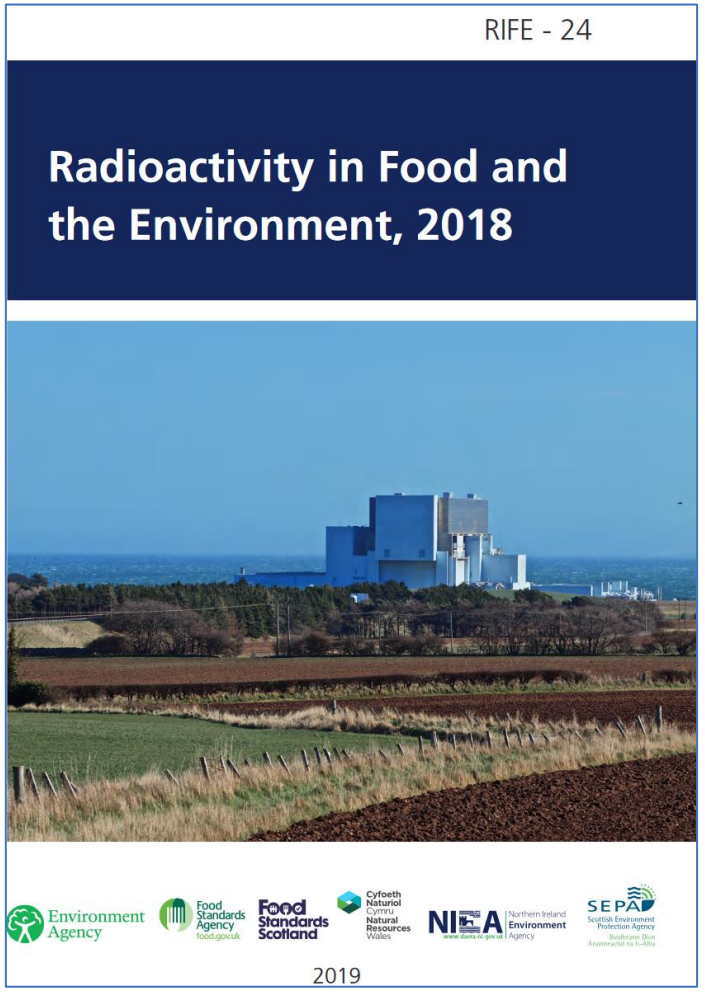
Virtual Workshop „Gaps in radiation protection metrology“,
Sebastian Feige, BfS, Sep 2020

Metrology Gaps (area 8): Education and training

- Metrological Competence
  - Education: Radiation metrological competence certification
  - Basic education: for practise
  - Expert education: like measurement uncertainty, E-Learning
  - Practical training: It is essential!
  - National / international qualification: Harmonisation needed!
  - Share experience: International efforts are needed, especially under COVID-19

Virtual Workshop „Gaps in radiation protection metrology“,
Paula Toroi, STUK, Sep 2020

- Emergency response
  - Involve people with local knowledge: farm management, local representatives
  - Utilization of scientists with a successful track record for practicality & rigour is essential.
  - Designated institute (DI): Competence and capability to response, lack of staff, lack of resources (suitable equipment, calibration fit for purpose)



Virtual Workshop „Gaps in radiation protection metrology“,
Paul Leonard, CRA, Sep 2020

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Summary and outlook

- The aim of the supportBSS project is to support the establishment of the European Metrology Network (EMN) for Radiation Protection to provide new metrological solution for the future.
- The implementation of a long-term ongoing dialogue between the metrology community and the relevant stakeholders is a basic requirement for the establishment of the EMN. This dialogue should help the EMN to engage the stakeholders by identifying their metrological needs and core interests.
- The virtual workshop „Gaps in RP metrology“, which took place on September 11, 2020, deals with the so-called gaps in radiation protection metrology and capacities either in the scope of the Council Directive 2013/59/EURATOM or in some aspects of the EURATOM treaty.
- The identified metrological gaps that were introduced by stakeholders during the workshop and by project partners consist of a variety of topics in the field of radiation protection.
- Since the results of the gap analysis will in future guide the supportBSS and EMN in the development of the Strategic Research Agenda (SRA) and Roadmaps, a process for mapping and prioritizing the gaps will be taken into account.
- The 2021 General Assembly of EURAMET e.V. approved **EMN for Radiation Protection!**

Thank you for your attention!

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