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## Publishable Summary for 19NET03 supportBSS Support for a European Metrology Network on reliable radiation protection regulation

### Overview

In recent years, the EU's radiation protection regulations have become ever more complex due to stricter legal dose assessments, exposure limits and activity concentrations as well as new technological developments and emerging complex practices. A European Metrology Network (EMN) is needed as a single point of contact to cover all the metrological needs related to radiation protection and to maintain reliable quality assurance. The [EMN for Radiation Protection](#) (RP) was founded as part of this project in September 2021. This project supports the EMN RP by identifying stakeholder research needs, implementing a long-term ongoing dialogue between them and the metrology community and installing a web platform for EMN RP. A Strategic Research Agenda (SRA) and two roadmaps will also be developed. Furthermore, long-term knowledge transfer and capacity building in Europe will be supported and a proposal for a sustainable European metrology infrastructure will be developed. This will significantly strengthen radiation protection in Europe.

### Need

Council Directive 2013/59/EURATOM lays down the basic safety standards for protection against the dangers arising from exposure to ionising radiation for workers, the public and the environment. The directive applies to any planned, existing or emergency exposure situation. It focuses on exposures which cannot be disregarded from a radiation protection point of view or with regards to the environment in view of protecting long-term human health. The updated directive also includes drastically reduced exposure limits, such as the dose limit for the eye lens or the radon activity concentration.

Furthermore, new radiation practices and new technological developments, such as pulsed fields in medical, industrial and technical applications have resulted in the use of radiation fields of growing complexity. Therefore, the metrology for radiation protection measurements and legal dose assessment is a highly complex task. It requires increased efforts in all member states to build up and maintain sustainable metrological competence. Increased digitalisation will lead to digital legal dosimetry over the next few years. Legal dose assessment and an associated dose registry is currently a national issue, but exposed workers are active internationally, therefore their personal dose values must be combined into a single value. This is only possible if dose assessment is performed in each country with the same level of reliability and that combining dose values is done based on harmonised data processing.

In the past, regulations were often implemented without consideration of the metrological implications. This led to cost inefficiencies in complying with radiation protection rules and the implementation of limit values that were hard to comply with in practice. With the introduction of shared specialist facilities, it will become possible to secure the protection goal without driving up costs.

### Objectives

The overall aim of this project is to develop a long-term ongoing dialogue between the metrology community and relevant stakeholders in the field of radiation protection regulation. This dialogue will support the collection of needs from stakeholders to inform future research and the take-up of research outputs from the metrology community.

The specific objectives are:

1. To establish regular, constructive dialogue and liaison between the project and stakeholders of radiation protection regulation. This will include (i) standards development and regulatory organisations related to Council Directive 2013/59/EURATOM, (ii) national and international bodies e.g. Heads of the European Radiological Protection Competent Authorities (HERCA), International

Atomic Energy Agency (IAEA), the European Radiation Dosimetry Group e.V. (EURADOS), (iii) manufacturers of radiation protection devices and (iv) medical staff.

2. To develop a web-based platform for radiation protection regulation stakeholders, taking into account feedback from stakeholders in Objective 1. The platform will include easy access to European metrology capabilities and regulatory requirements, i.e. for the Council Directive 2013/59/EURATOM, as well as a service desk to answer stakeholder's questions. The platform will also be developed in a manner that allows it to be maintained by a future EMN.
3. To develop a Strategic Research Agenda (SRA) and roadmaps for metrology services underpinning radiation protection regulation, in particular with respect to (i) safety, (ii) technical application and (iii) environmental factors, taking into account feedback from key stakeholders in Objective 1. The SRA and roadmaps will take into account existing national priority lists and on-going initiatives and networks such as the IAEA/WHO Secondary Standards Dosimetry Laboratory (SSDL) network, EURADOS and EURAMET TC-IR (Ionising radiation). The SRA shall address the measurement of ionising radiation in the workplace and environment as required by the EURATOM TREATY articles 31, 33, 35 and 36 where it is appropriate.
4. To set up and promote a knowledge-sharing programme for stakeholders in order to support the dissemination and uptake of results, including those from previous, relevant EU research, taking into account feedback from stakeholders in Objective 1. This will include a range of regularly hosted activities for a wide range of stakeholders, such as the exchange of researchers between organisations, metrology workshops, training courses and interlaboratory comparisons.
5. To develop a plan for a joint and sustainable European metrology infrastructure underpinning radiation protection regulation. The initial plan was created within 12 months of the start of the project and addresses how to (i) develop coordination and smart specialisation of capabilities, (ii) integrate existing Quality Assurance infrastructure and type testing laboratories into the joint infrastructure, (iii) align with other running initiatives and with TC-IR, (iv) promote the development of emerging member states, and (v) consider an extension of the collaboration to third countries.

## Results

### *Objective 1 - Establish regular dialogue and liaison with key stakeholders interested in radiation protection regulation*

Stakeholders in the field of radiation protection have been identified, grouped, and analysed in terms of their needs, interests, and their level of involvement. Using this information, the project has implemented a databank which includes the following groups: standards development and regulatory organisations, national and international organisations and bodies, e.g. HERCA, EURADOS, IAEA, ICRU (International Commission on Radiation Units and Measurements), ICRP (International Commission on Radiological Protection), manufacturers of radiation measurement devices and medical staff organisations. The databank provides information on the needs, capacity, interests, and activities of these stakeholders. A workshop was held to review this information and subsequently create a stakeholder map, allowing the EMN to prioritise stakeholders. Information about potential risks and misunderstandings, mechanisms to positively influence stakeholders, key organisations to be informed about the network project during the execution phase and in the EMN in foundation phase was also collected. Based on this, a communications strategy document has been finalized. Additionally, a newsletter to inform stakeholders in the EURAMET community about the work of the project and EMN has been published by EURAMET. A draft for a second newsletter has been created, and the newsletter will be published shortly.

### *Objective 2 - Development of a web-based platform*

The EMN RP will establish a comprehensive web platform for radiation protection regulation. The web platform will be designed and implemented to serve as a contact point for the metrology community, stakeholders and other end users of radiation protection and enable easy interaction and exchange of information. Technical specifications and administrative requirements for the future web-based platform have been collected and defined based in part from the review of other web-based platforms e.g., NMIs, calibration service providers,

EURADOS and other EMNs. The web platform has been drafted and will be updated with content (e.g. on the stakeholders and strategy of the EMN) in the coming months.

Currently, internal sharing of information within the project such as news on activities is achieved via the Radiation Protection EURAMET SharePoint.

### *Objective 3 - Development of the SRA and roadmaps*

As an initial step in the development of the SRA and roadmaps, the project organised and held a workshop on analysing the gaps in radiation protection metrology in September 2020. This workshop was attended by more than 100 experts from more than 40 institutes active in radiation protection worldwide but mainly in Europe. The workshop allowed for a preliminary identification of important issues for metrology, such as, reference fields, activity standards, operational quantities in radiation protection, radiation measurement devices, type testing and infrastructures, including the identification of education and training and harmonisation needs.

A draft document providing a summary of the main findings from the workshop in 2020 was prepared and was circulated within the participants. It was used among the project partners and in the interaction with stakeholders for the development of the SRA and the roadmaps. The results were presented at the 9th International Conference on Radiation in Various Fields of Research (RAD 9) conference in 2021 and was published in the conference proceedings [3].

In the second step, the perspective of the Radiation Protection platforms (e.g. MELODI, EURADOS, EURAMED, NERIS, ALLIANCE and SHARE) in each specific field (respectively, radiobiology, dosimetry, medical applications of ionizing radiation, emergency preparedness and response, radioecology and social sciences) was identified together with the perspective of relevant organisations and consortia (e.g. ICRP, HERCA, IAEA, BIPM-CCRI, EURAMET, CONCERT and SAMIRA). In addition, the SRAs from the platforms and organisations listed above were collected, reviewed, and summarised and the results fed back into the draft summary document.

Due to resources and to create maximum value for stakeholders, the scope of the draft summary document was limited to needs related to the European Council Directive 2013/59 EURATOM and the EURATOM Treaty regulations. In order to further elaborate on these needs, additional key questions for stakeholders were formulated in the SRA workshop held as part of this project. Based on this, an online questionnaire was launched in 2023 and sent to stakeholders to collect their feedback.

A further step in the development of the SRA was the attempt to link other Radiation Protection regulations with the identified metrology needs, such as:

Council Directive 2013/51/EURATOM (radioactive substances in water for human consumption); 87/600/Euratom Council Decision (early exchange of information in the event of a radiological emergency); Regulation 2017/745 on medical devices; COUNCIL DIRECTIVE 2011/70/EURATOM (safe management of spent fuel and radioactive waste); Council Regulation 2016/52/Euratom (food and feed stuff in case of radiological emergency); Directive 2010/75/EU on industrial emissions; COUNCIL DIRECTIVE 2014/87/EURATOM (safety of nuclear installations). In this context, a draft paper entitled "Metrology supporting the European regulation for Radiation Protection" has been prepared and will be submitted for publication.

It is expected that the draft summary document (full or in parts), the questionnaire and the draft paper will guide stakeholders in identifying the metrology needs in each area of radiation protection to support the relevant Radiation Protection regulation during the SRA development in 2023.

### *Objective 4 - Set up and promotion of a knowledge-sharing programme*

Based on a preliminary gap analysis of knowledge-sharing activities, the project will conduct a pilot study and an informal intercomparison, support the exchange of scientific staff, and organise two training courses, one in combination with a hands-on training.

The pilot study will be organized by PTB at the end the project and will be open to all project partners and EMN members and partners. For the study, a set of passive personal dosimeters will be sent to each participant. After irradiation to a known dose level using the X-ray qualities N-30 and N-100 and Gamma radiation from <sup>137</sup>Cs and <sup>60</sup>Co sources, they will be sent back for evaluation.

Further comparison needs were discussed and highlighted at the 2<sup>nd</sup> EMN Meeting. These include an informal intercomparison at the X-ray facility at VINS. VINS plans to perform the intercomparison on-site in September 2023. Project partners and EMN members and partners have been invited to attend.

At the 2<sup>nd</sup> EMN Meeting, the EMN members and partners recognized the urgent need for these knowledge sharing activities. The TC-IR Chair expressed his interest to be informed about the pilot study to maximize the benefit for EURAMET. Results from the pilot study (particularly related to training) will be used to increase the confidence in existing CMCs, but not directly to establish or support them.

Furthermore, a survey on stakeholder needs for knowledge transfer and capacity building in the field of radiation protection metrology was launched and sent to stakeholders gather their feedback on gaps and needs in knowledge transfer and capacity building. The results were analysed and incorporated in the development of the knowledge sharing and capacity building programme.

*Objective 5 - Plan for a sustainable European metrology infrastructure to underpin radiation protection regulation*

The project has developed a preliminary plan for a joint and sustainable European metrology infrastructure underpinning radiation protection regulation in the proposal for the EMN and the MoU for the EMN RP. The plan was re-evaluated by EURAMET successfully. According to this, the EMN RP was presented to the GA of EURAMET in June 2021 as a candidate for an EMN and approved.

On 16 September 2021 the EMN was formally established by the signature of the first members and partners. PTB and EURAMET issued press releases. EURADOS issued a newsletter. The kick-off EMN meeting was held on 29 September 2021 with 53 participants and with contributions from EURAMET, EURAMET TC-IR, BIPM and IAEA.

On 13 April 2022, the 2<sup>nd</sup> EMN meeting was held in hybrid form at IST, Portugal. Key stakeholders (BIPM/CCRI, IAEA, TC-IR, ICRP) presented their needs to the EMN and project consortium presented their results. The topic of a sustainable European metrology infrastructure was also discussed.

In 2023, new partners CLOR - Central Laboratory for Radiation Protection and Eckert & Ziegler - Eckert & Ziegler Strahlen- und Medizintechnik AG have joined the EMN. The statements of the new EMN partners and key stakeholders were presented at the EMN RP Annual General Meeting 2023 on 15 June 2023 in Porto.

The aim for a sustainable European metrology infrastructure to underpin radiation protection regulation was presented to several different scientific audiences: Medical societies, environmental societies and radiation protection organisations. Publications like <https://doi.org/10.5194/adgeo-57-1-2021> [1] presented the overview and raised the awareness of the new structural element “EMN” under EURAMET.

## Impact

### *Dissemination*

A stakeholder committee was formed with 17 members from different branches (e.g., industrial and technical applications, medical applications, national authorities and boards, organizers of emergency management, research institutes / universities and international standardisation organisations). At the EMN RP Annual General Meeting (AGM) 2022 in Lisbon, it was agreed to invite representatives of IAEA, CCRI, TC-IR and ICRP to be key stakeholders of the EMN RP. These invited stakeholders form the core group of the Stakeholder Committee and will help to channel the communication of the EMN RP towards its stakeholders. The stakeholder committee contributed actively to the proposal for an EMN RP, to the gap analysis workshop and to discussions in web conferences. The project is promoting the early uptake of project outputs by end users, to be taken forward by the EMN RP through appropriate dissemination of the project results to international bodies and standardisation organisations.

The results and outputs are being actively communicated to the wider metrological community, to stakeholders, and to end-users, including NMIs/DIs not participating in the project, in several presentations at various events and meetings such as the virtual conference on applied radiation metrology (vCARM) 2020 and BIPM's Consultative Committee for Ionizing Radiation (CCRI) webinar which exclusively promoted the EMN RP worldwide. In addition, presentations have been given at the General Assembly (GA) of EURADOS and EURADOS WG 3 meeting as well as at EURAMET TC-IR meeting.

A CCRI webinar took place on radiation protection on 5<sup>th</sup> November 2020 organised by BIPM and run by Annette Roettger. It had more than 150 attendees representing experts worldwide. The TC-IR working group “Ionising Radiation and Radionuclides in Environment, Energy and Industry” was consulted in parallel. Through this intensive exchange, the EMN was able to provide information to EURAMET on future call scopes, topics of the 19th Joint Meeting TCC / EMNC / BoD / WG convenors Agenda as well as the Horizon Europe Work Programme for 2021-2. Moreover, input was provided to the Joint Workshop TC-IM WG M4D.



In the 2022 GA of EURADOS, EURADOS Chair Filip Vanhavere presented the potential EMN RP to an audience of 800 participants worldwide to inform the members about the cooperation between EURAMET and EURADOS. In the annual meeting of EURADOS, the consortium presented first results in the WG 3.3 with a special focus on the environmental aspects. EURADOS is supporting the EMN RP by providing communication channels to the EURADOS members and has joined the EMN as a partner.

On 5 and 6 October 2022, EURAMET and the EMN RP hosted an online event for Stakeholders: 'Support for technological trends: EURAMET's Work Programme on Metrology for Industry'. In this brainstorming workshop, different radiation protection experts took up the opportunity to exchange ideas and possible solutions for unsolved radiation protection challenges in the field of: Radon measurements, the future of neutron dosimetry, flash therapy, the implementation of new operational quantities, metrology of pulsed fields, occupational radiation safety and dose estimation and the measurement capabilities at nuclear power plants. On 10 May 2023, following the first PIANOFORTE Open Call event for research projects, the EMN RP hosted a short brainstorming session and online discussion on the topic "EMN for Radiation Protection: PIANOFORTE Needs and Information Sharing".

#### *Longer term impact*

The EMN will support a quality-assured metrological infrastructure for radiation protection and legal dose assessment as required by Directive 2013/59/EURATOM and the EURATOM Treaty. It will aim to create coherent procedures in calibration and type testing according to international standards such as those of IEC and ISO. This will support the development of all types of equipment (sources, detectors, dosimeters) in a rapidly growing harmonised European market in radiation protection and address the needs of users in complying with the requirements of the regulation. Thus, this project and EMN will make important contributions to ensure the long-term economic competitiveness of predominantly small and medium-sized equipment manufacturers as well as numerous industrial and other end users.

This project and EMN will extend the capabilities and capacities in Europe towards non-NMIs or non-DIs. This includes groups dealing directly with the EURATOM Treaty in regard to environmental monitoring in Europe, passing their data on to the Joint Research Centre to be used in EURDEP (European Radiological Data Exchange Platform) and EARN (European Atlas of Natural Radiation) as well as groups underpinning Directive 2013/59/EURATOM in calibration, service and knowledge sharing of radiation protection organised under EURADOS. In addition, emerging laboratories will benefit from the experience and expertise of project partners to accelerate their development and optimise the use of their resources.

The development of the EMN and in particular the web-based platform will benefit international organisations and standardisation bodies, such as ISO TC85, IEC TC45 and CENELEC. These organisations currently give guidance in the field of radiation risks, dose assessment, technical and metrological state of the art but do not link the metrology directly to the needs expressed in regulation.

The roadmaps for the metrology needs of i) Directive 2013/59/EURATOM and ii) the EURATOM Treaty will be communicated to CCRI and used by BIPM (International Bureau of Weights and Measures). The direct involvement of CCRI and BIPM will have high-level impact on the work of the international organisations mentioned above, combining efforts world-wide.

A harmonised metrological infrastructure for radiation protection will provide support to deal with the European challenge of digitalisation, for example a digital quality-assured dose register. This will promote free trade and travel in Europe.

A long-term collaboration of all relevant partners in the field will provide a valuable basis to steer joint developments at a European level. Fostering this mutual exchange of expert knowledge will not only identify routes for innovative metrology but may also provide input for legal processes, feedback to legislation, standardisation and common research activities directly responding to European legal requirements. It will also ensure the optimal use of resources across Europe.

The EMN will provide the basis upon which to implement and to guarantee metrological quality in radiation protection for all European citizens by harmonising procedures and combining the capabilities in service and research (i.e. calibration, type testing and reference fields). This requires a coordinated approach to ensure that the required metrological quality in the dissemination of the radiation protection quantities is reached for all dose assessments performed under 2013/59/EURATOM.

Finally, the EMN will provide metrological based quality assessment (QA) for all radiation protection issues. Thus, the final goal of radiation protection will be achieved: The "ALARA" ("As Low As Reasonably Achievable") principle is reached for every citizen of the European Union alike.

## List of publications

1. Röttger, A., Veres, A., Sochor, V., Pinto, M., Derlacinski, M., Ioan, M-R., Sabeta, A., Bernat, R., Adam-Guillermin, C., Gracia Alves, J.H., Glavič-Cindro, D., Bell, S., Wens, B., Persson, L., Živanović, M. and Nylund, R: Metrology for radiation protection: a new European network in the foundation phase, Adv. Geosci., 57, 1–7, 2021, <https://doi.org/10.5194/adgeo-57-1-2021>
2. Bell, S., Glavič-Cindro, D. (Jožef Stefan Institute, Ljubljana, Slovenia), ALVES, J., Adam-Guillermin, C., Bernat, R., Sabeta, A., Ioan, M-R., DERLACINSKI, M., Pinto, M., Sochor, V., Veres, A., RÖTTGER, A., Živanović, M., Wens, B., Persson, L., Nylund, R., Kržanović, N., Stankovic, S. and Dimovic, S.: A NEW EUROPEAN RADIATION PROTECTION NETWORK DEVELOPED BY THE SUPPORT BSS JOINT NETWORK PROJECT, Radiation Protection society of Serbia and Montenegro, proceedings, XXXI symposium RPSSM, 2021, e-ISBN 78-86-7306-161-0, p. 309, <https://vinar.vin.bg.ac.rs/bitstream/handle/123456789/10125/309-314.pdf>
3. Khanbabaee, B., Röttger, A., Behrens, R., Röttger, S., Feige, S., Hupe, O., Zutz, H., Toroi, P., Leonard, P., de la Fuente Rosales, L., Burgess, P., Gressier, V., Gutiérrez Villanueva, J–L., Cruz Suárez, R. and Arnold, D: SUPPORT FOR A EUROPEAN METROLOGY NETWORK ON RELIABLE RADIATION PROTECTION: GAPS IN RADIATION PROTECTION AND RELATED METROLOGY, RAD Conference Proceedings, vol. 5, pp. 21–27, 2021, ISSN 2466-4626 (online), <https://doi.org/10.21175/RadProc.2021.04>
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This list is also available here: <https://www.euramet.org/repository/research-publications-repository-link/>

Project start date and duration:		01 June 2020, 48 months
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Internal Funded Partners:	External Funded Partners:	Unfunded Partners:
<ol style="list-style-type: none"> <li>1. PTB, Germany</li> <li>2. CEA, France</li> <li>3. CMI, Czech Republic</li> <li>4. ENEA, Italy</li> <li>5. GUM, Poland</li> <li>6. IFIN-HH, Romania</li> <li>7. IMBiH Bosnia and Herzegovina</li> <li>8. IRB, Croatia</li> <li>9. IRSN, France</li> <li>10. IST, Portugal</li> <li>11. JSI, Slovenia</li> <li>12. NPL, United Kingdom</li> <li>13. SCK CEN, Belgium</li> <li>14. SSM, Sweden</li> <li>15. VINS, Serbia</li> </ol>		<ol style="list-style-type: none"> <li>16. STUK, Finland</li> </ol>