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Editorial

A large variety of topics are contained in this 41th issue of the European ALARA Newsletter. Is it because radiation protection continue to concern an increasing number of people from different professional groups; medical; aviation, industry etc. as highlighted by the analysis of the German Occupational Radiation Protection Register (*page 2*)?
Or is it because specific and concrete radiation protection challenges will need to be addressed in the short term, such as the decommissioning of nuclear installations (*page 6*)? And what about installations not per se in the nuclear fuel cycle, like former NORM facilities? Is the application of ALARA different there? These, and other, topics will be discussed during EAN workshop n°18 (11-13 March 2019, Marcoule, France, *page 9*), jointly organised with ISOE.

If we continue to consider the future, the research undertaken in the field of radiation protection is a vivid topic as can be seen from the feedback from the 3rd European Radiation Protection Week and the content of the CONCERT research programme (*page 12*).

The EAN does not stand still; EAN Workshop n°19 will discuss the use and development of (innovative) ALARA Tools (December 2019, Greece, *page 24*). This is jointly organised with the PODIUM project, part of the CONCERT projects.

Is there too much work to do? Fortunately, new networks are coming on board and the EAN welcomes the foundation of the African ALARA Network (*page 18*) and the launch of the IRPA Young Generation Network (*page 19*).

The EAN Newsletter Editorial Board. –
Sylvain Andresz, Julie Gilchrist, Pascal Croüail and Fernand Vermeersch

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Occupational Radiation Protection in Germany – The Radiation Protection Register (SSR) of the Federal Office for Radiation Protection (BfS)

T. Rosentreter, U. Oeh

Bundesamt für Strahlenschutz (BfS) – Federal Office for Radiation Protection
85762 Oberschleissheim, GERMANY

Corresponding author: uoeh@bfs.de

The Radiation Protection Register (SSR) is a facility of the Federal Office of Radiation Protection (BfS) and functions as the central dose register for the monitoring of occupational radiation exposure in Germany. Its main tasks, as laid down in the Atomic Energy Act, are the continuous monitoring of the annual and lifetime body dose limits of occupationally exposed persons and the issuance of the radiation passport for external personnel. At the beginning of 2019 the duties of the SSR will be stipulated in the new legally valid Radiation Protection Act.
Besides tasks related to surveillance, the SSR regularly performs statistical analyses of the monitored personnel and their radiation exposure grouped by various aspects such as occupation, age, sex etc. A solid and broad knowledge in that respect is the basis to enforce the radiation protection principle of "Optimisation".

The continuously growing database now comprises data reaching back for several decades, and has thus become of considerable importance for epidemiological research. To date (status 08/2018), the SSR lists a total of 1,810,455 radiation protection monitored persons with a total of 99,867,079 individual data sets that have been transmitted within the last decades. By supporting various research groups with data from this extensive database, the SSR facilitates future developments concerning occupational radiation protection according to the state-of-the-art of science and technology.
Moreover, the SSR is engaged in various international working groups promoting the standardisation of occupational radiation protection in Europe.

Statistical evaluation of the year 2017

At present, the SSR monitors about 450,000 occupationally exposed persons in Germany (monitored persons including 45,000 owners of radiation passports) in various working areas: medical sector, nuclear power engineering, industry, research and development, aviation, workplaces with high exposure to naturally occurring radioactive sources.

Figure 1 displays the percentage of all monitored persons in Germany grouped by working area. The medical sector represents with 68% of all monitored people by far the largest group followed by aviation (10%), industry (9%), research and development (4%), nuclear power engineering (3%) and finally workplaces with natural radioactive sources (< 0.1%). The group "other" includes all personnel where no information about the working sector is available.

Figure 2 shows the percentage of all actually exposed persons, namely those persons who have received an effective dose larger than the minimal detection level of 0.1 mSv during the year 2017. Particularly two working areas show notable deviations in comparison to figure 1: aviation and medical sector. Although only 10% of all monitored people in Germany are aircraft crew, they represent the largest group (45%) of all actually exposed persons. In contrast, the percentage of medical staff decreases from 68% to 41% if only actually (measurably) exposed workers are taken into account. This is a consequence of the specific working environments: aircraft crew are continuously exposed to cosmic radiation as soon as they leave the ground. The dose of each employee is calculated by means of special dosimetry programs accounting for factors such as altitude, sun cycle, latitude and duration of flight. For medical workers, in contrast, radiation exposure can be reduced or even avoided by appropriate radiation protection measures. As a consequence, a large amount of persons working in the medical field is actually (measurably) not exposed to radiation although it is monitored.

Figure 3 displays the average effective dose grouped by working area that each employee received during the year 2017, together with the absolute number of personnel occupied in this field. Persons working in the largest working area, the medical sector, received an average dose of 0.3 mSv. Only employees working in research and development received fewer doses with an average dose of 0.2 mSv. Personnel employed in the fields of nuclear power engineering and industry still received radiation doses of less than 1 mSv, namely 0.6 mSv and 0.9 mSv, respectively. As already explained, aircraft personnel is permanently occupationally exposed, which is reflected in the average annual dose of 2.1 mSv. Workers in environments including natural radioactive sources, i.e. mainly radon collected a comparable annual effective dose of 2.1 mSv. Similar to cosmic radiation, exposure to natural sources like radon can hardly be avoided or is partly even still ignored to a certain extent, so that the highest effective doses are seen for people in these sectors.

Figure 4 delineates timelines of the average annular effective dose for different working areas from 2007 to 2017. The figure demonstrates a slight decrease in the average annual effective dose for people working in the medical sector and in research and development. A more significant reduction in dose exposure has been achieved in industry and nuclear power engineering. This shows very well the effort of efficient occupational radiation protection measures over the last decade. In contrast, workplaces with exposure to natural occurring radioactive sources do not show any consistent trend, rather than a strong fluctuation throughout the past ten years. This might be a consequence of the small amount of persons occupied in this field leading to statistical effects. There is a notable reduction in the average effective dose for aircraft crew members until the year 2015. The reason for this, however, is different than that for other sectors: The intensity of cosmic background radiation and consequently the resulting effective dose to the personnel, is highly dependent on the activity of the sun, which follows an 11-year cycle of years with high activity and years of low activity. Since high sun activity causes shielding against cosmic rays, the effective doses of aircrew personnel are increased during that time and vice versa. Sun activity and dose thus are anti-cyclic. With the last maximum of sun activity in 2013/2014, the doses for aircrew personnel were at a minimum of 1.9 mSv. The next minimum of sun activity is expected within the next years, which will be followed by an increase in average dose comparable to that around 2009 of 2.4 mSv. ■

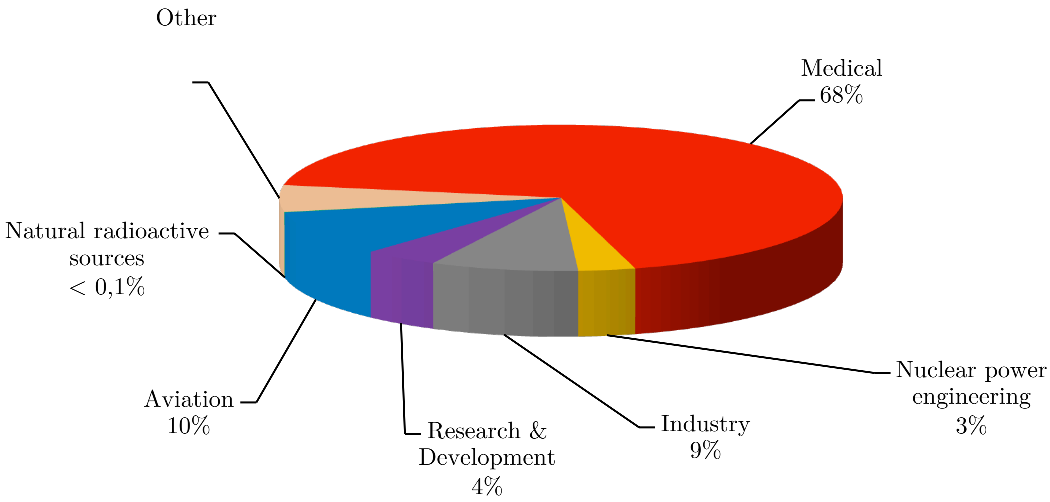

Figure 1 – Percentage of all monitored persons of Germany in 2017 grouped by working area.

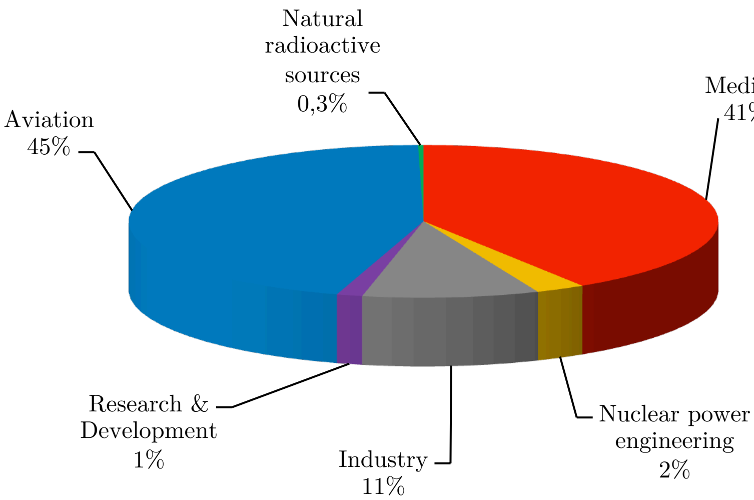

Figure 2 – Percentage of actually exposed persons in Germany in 2017 (> 0.1 mSv) grouped by working area.

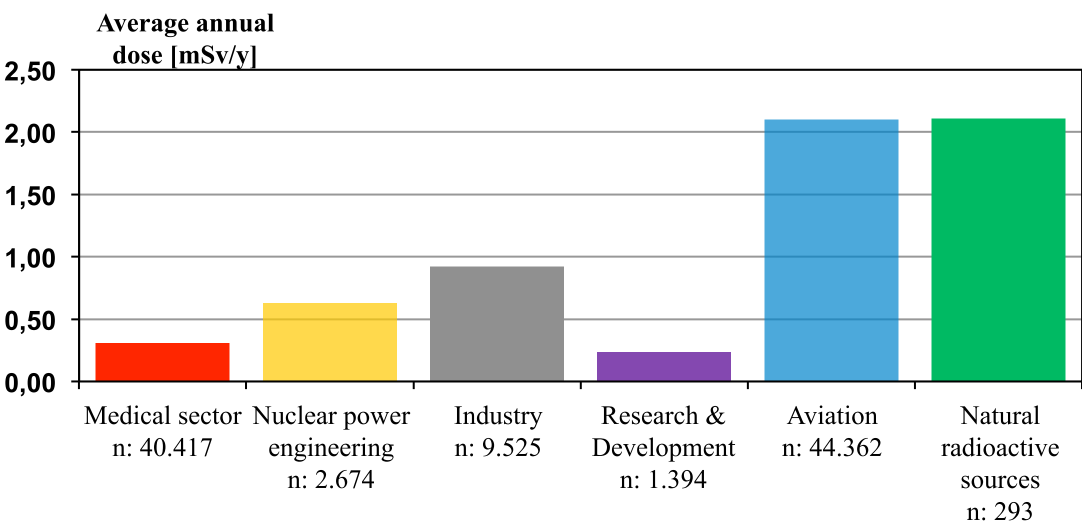

Figure 3 – Average annual effective dose of actually exposed persons in Germany in 2017 grouped by working area (n = numbers of actually exposed persons).

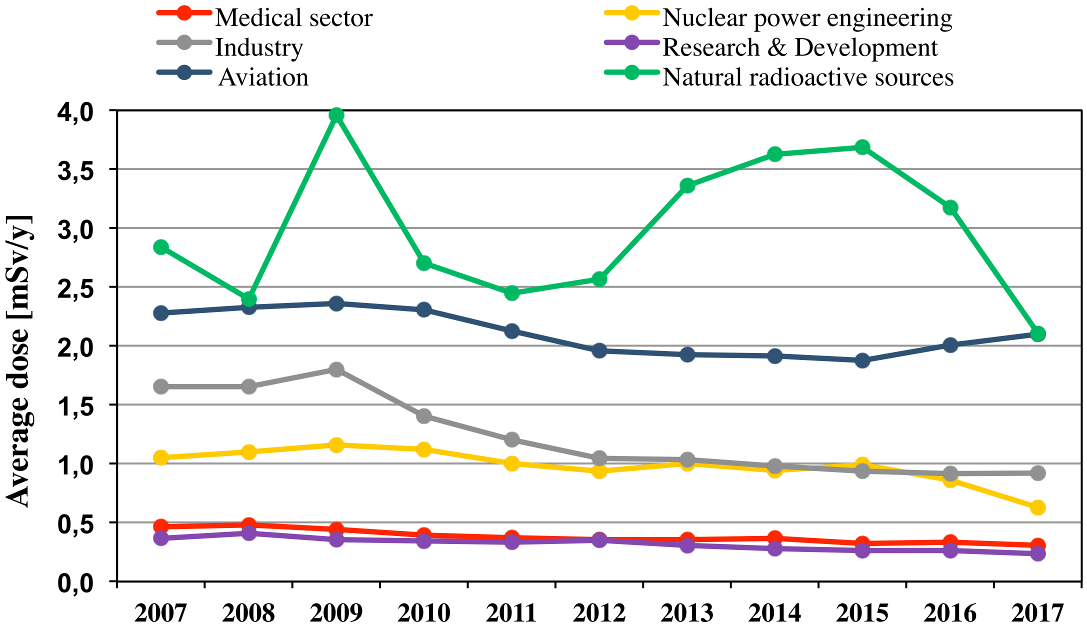

Figure 4 – Timelines of the average annual effective dose of actually exposed persons in Germany from 2007-2017 grouped by working sector.

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ALARA Approach in the dismantling of Hot Cell M2 of the installation LHMA at SCK•CEN Mol

P. ANTOINE, M. ESTAS, F. VERMEERSCH

SCK•CEN
Boeretang 200, B-2400 Mol BELGIUM

Corresponding author: philippe.antoine@sckcen.be

Introduction

The Belgian Nuclear Research Centre SCK•CEN is a federal organization for scientific research in the domain of the peaceful applications of ionizing radiation (safety of nuclear installations, solutions for radioactive waste disposal, radiation protection, sustainable development and education). Among the installations of this research centre, the Laboratory for high and medium level activity (LHMA) enables the manipulation of highly radioactive sources in a series of hot cells, in the framework of monitoring programs of reactor vessel steel and nuclear fuels.

Description Hot Cell M2

The cell M2, together with cell M1, forms a set of hot cells intended to study irradiated fuels. Cell M1 is always used to perform post irradiation non-destructive studies (gamma-rays scanning, visual inspection, stereo photographic documentation, Eddy current measurements, RX picture, …) on fuel elements.

Hot cell M2 was equipped to realize different cuts on irradiated fuel elements to be analyzed in cell M1. To do this, the cell was equipped with a mechanical lathe, a milling machine and cutting devices. A horizontally and vertically movable table formed the working surface. Prior to the dismantling operation, the cell had not been operational for several years.

The internal volume of the cell is 3 x 3 x 5 m. Radiological protection is provided by barium concrete in which lead balls were added at the construction stage to increase its density. The concrete thickness on the front and at ground level is 1 m, in the other directions it varies from 0.6 to 0.8 m. A stainless steel liner is present inside the cell.

Hot cell M2 is equipped with two telemanipulators and three vertical storage channels (1.5 m deep). A travelling crane, present inside the cell, allowed manipulation of loads up to 3 t.

At the back of the cells M1/M2 a permanent alpha intervention zone exists. This ventilated zone gives access to the doors (shielded doors followed by an alpha-tight door) allowing access the interior of each cell.

An access through the roof (1.6 x 2.1 m) also existed. Cell M2 was connected with a lock to cell M1, and was equipped with a La Calhène lock, allowing the connection of containers.

Initial state at the beginning of the dismantling

The mechanical and radiological state of the cell was very poor, at the start of the dismantling process.

From a mechanical point of view, the two existing tables were blocked and the different equipment in the cell presented several failures. An accumulation of waste was identified. It was also impossible to carry out transfers through the La Calhène lock (lead shielding and lock blocked). The two normal ventilation systems for the cell were out of use and ventilation was achieved using the emergency ventilation. Access to the cell was blocked due to the non-functioning worktables.

The radiological situation also provided some challenges. The dose rates inside the cell varied from 140 up to 180 mGy/h, with several hot spots up to 4 Gy/h. An old experiment, located inside one of the storage channels presented a dose rate of 8 Gy/h at 30 cm from the lead shielding.
The beta-gamma contamination was estimated to 27.5 GBq/dm^2. The main isotopes were ^{137}Cs, ^{134}Cs, ^{154}Eu, ^{241}Am, ^{106}Ru, ^{57}Co, ’^{155}Eu, ^{60}Co, etc.
The alpha contamination was around 1.88 GBq/dm^2. The present isotopes were ^{242}Cm, ^{238}Pu, ^{241}Am, $^{239/240}$Pu, etc.

Strategy and course of the dismantling

The present project was limited to the dismantling/decontamination of the interior of cell M2, with the existing shielding around the cell remaining in place. The final goal was to refurbish the cell for new applications.

The first dismantling strategy considered consisted of a remote decontamination of the different items present, transferring them, via the opening in the roof of the cell, to an intervention zone to be built, where these items would be manually cut and evacuated in waste drums. Decontamination by means of CO_2 ice blasting was considered, to minimize the secondary waste inside the cell. This strategy had been applied in the past (at the exception of the decontamination) for another cell (HC 41) that had contained nuclear fuel. In comparison with cell M2, cell 41 was much smaller and the dose levels encountered lower.

It appeared however that the remote decontamination of the different items presented difficulties when considering if the dose levels would be acceptable for the operators in the intervention zone above the cell. This first strategy was therefore abandoned.

A new strategy was then defined. This consisted of restoring the operation of the support infrastructure, such as the La Calhène lock and the normal ventilation of the cell, to carry out cuts remotely of all equipment present inside the cell (via the telemanipulators). Specific tools were developed and new ways to evacuate the waste were created.

The concept of the intervention zone, above the cell, was adapted so waste could be transferred remotely. The waste cut inside the cell was stored in a 220 L basket, inside a 400 L DDS drum (double lid system) and a concrete storage BPIII container. The waste was categorized as MAVA – Wastes (Moderately Active – waste).

All these operations occurred remotely so the resulting doses levels for the operators were therefore limited.

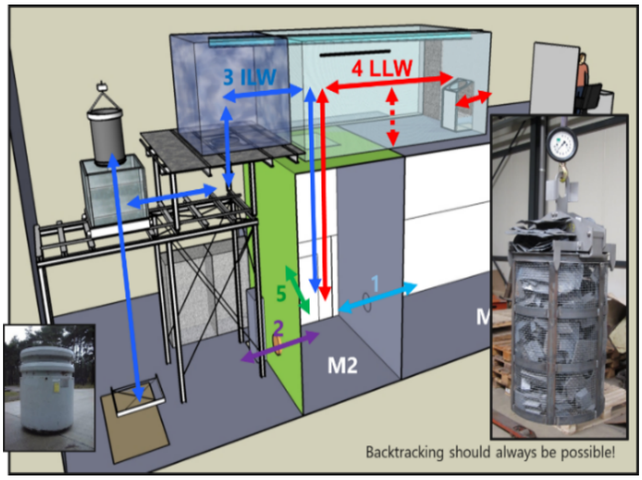

Figure 1. – New evacuation ways for the evacuation of wastes

Once the cell was completely emptied of its contents, a remote decontamination stage (via the manipulators) was started. A surfactant and foaming product was applied at low pressure to the different surfaces to be decontaminated. After a duration of about ½ h to 1 h, the product was rinsed with water at the same pressure using the telemanipulators.

The selected process used a limited volume of water. After each decontamination operation the resulting volume of foaming product/water was collected in a drum equipped with heating coils. This allowed the evaporation of the water, concentrating the activity inside the drum.

The remote decontamination operations progressively reduced the dose levels inside the cell. When dose rate levels inside the cell reached 2 mSv/h, it was decided to continue decontamination operations using high pressure cleaning, with direct intervention in the cell. Before this action was possible, the access to the cell via the a zone at the back of the cells M1/M2 had to be restored including the repair of the seals of the door.
In addition, a scaffold structure was built inside the cell to access the top of the cell and to dismantle the travelling crane. After the high pressure cleaning decontamination was also continued manually.

Dosimetric results

The dismantling of the contents of cell M2 between 2010 and 2018 has led to a global collective dose of 47.169 man.mSv (48.640 taking into account the preparation of the project before 2010). The remote evacuation of the majority of the present activity (143 TBq, with a resulting collective dose of 0.959 man.mSv) considerably reduced the doses received by the operators during the later stage of intervention inside the cell.

The construction of the intervention zone above the cell led to a collective dose of 1.544 man.mSv. The operations in this intervention zone resulted only in limited doses (1.963 man.mSv). The majority of the doses (42.703 man.mSv) were received during the interventions inside the cell such as the decontamination operations with high pressure cleaning, the manual decontamination, the construction of the scaffolding and the dismantling of the travelling crane.

It is also interesting to investigate the ratio between Hp(10) et Hp(0.07). As long as the operations occurred outside the cell, the ratio was around 1. The ratio varied from 3 to 5 for all interventions inside the cell. This result can be explained by taking into account the strong b component of the contamination present, due to the manipulations on irradiated fuel that were performed in the cell during its operation.

Conclusions

The dismantling project of cell M2 consisted of dismantling the inner parts of the cell. The mechanical and radiological state of the cell was very poor at the start of the dismantling. Dose rate levels from 140 to 180 mGy/h and hot spots of 4 Gy/h were measured. The strategy to reduce the doses to the operators relied on the remote dismantling of the inner parts of the cell and transferring them to concrete storage casks. This was followed by a first decontamination also performed remotely. Once the dose rate level in the cell reached the level of 2 mSv/h further decontamination using high pressure cleaning, and the removal of the travelling crane, was performed by human intervention. The collective dose received by the workers in the dismantling project (2010-2018) was 47.169 man.mSv.

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WOULD YOU LIKE TO KNOW MORE ABOUT DECOMMISSIONING?

A New Database of Activity Concentrations, Radon Emanations and Radon Exhalation Rates of Building Materials in the European Union

C. NUCCETELLI

Istituto Superiore di Sanità (Italian National Institute of Health) – National Center for Radiation Protection and Computational Physics, viale Regina Elena, 299 00167 Rome, ITALY

Corresponding author: cristina.nuccetelli@iss.it

Background

Due to their natural origin and radionuclide content, building materials can cause significant gamma exposure indoors and contribute to the indoor radon concentration and for this reason are within the scope of the Euratom Basic Safety Standards Directive (1). Recently a new database reporting radiological information on activity concentrations, radon emanations and radon exhalation rates of many building materials used in European Union has been published (2). It is the update of a data collection -published in 2012- of the activity concentrations of ^{238}U(^{226}Ra), ^{232}Th and ^{40}K of about 10 000 samples of building materials used in 25 of 27 European Union Member States (EU MS) (3). This database was based on a wide review of the relevant literature, in particular the 1996 European Commission (EC) publication (4) and a study on Italian building materials conducted in 1999 (5). It is interesting to remember that the 1996 EC publication (3) was the data source for the elaboration of the EC technical guidance for the regulatory control of building materials RP 112 (6), and that the RP 112 approach has been adopted by the Euratom Basic Safety Standards Directive (1) to introduce and implement the regulatory control and screening of building materials of radiological concern.

New data

The new database is significantly richer compared with the previous one (3). It comprises measurements of natural radionuclide activity concentrations (^{226}Ra, ^{232}Th and ^{40}K) of about 23 900 samples used in 26 of 28 EU MS, in 2 EU candidate countries (the former Yugoslav Republic of Macedonia and Turkey) and in 2 non-EU countries (Norway and Switzerland). Where available, radon emanation/exhalation rate information concerning about 1120 building material samples have also been collected. Moreover, for another 370 samples without data concerning activity concentrations only information related to radon emanation/exhalation rate was collected. The updating procedures have been carried out through a broad review of international and some national literature, including peer reviewed papers, reports and personal communications. All data have been carefully checked and validated, mainly in order to avoid mis-classification and multiple counting of identical sets of sample information reported in different papers. This database includes activity concentration measurements of several categories of building materials, in particular:

- products used in bulk amounts (bricks, concrete, cements): about 8400 samples;
- aggregates (sand, gravel, etc.): about 3600 samples;
- natural raw materials (tuff, lime, clay, gypsum, etc.) used in bulk amounts and for some superficial application: about 2100 samples;

- industrial by-products: by-product gypsum (434 samples), coal ashes (5908 samples), metallurgical slags (774 samples) and bauxite residues/red mud (71 samples); total about 7190 samples;
- others such as wood, tiles, etc. (about 1550 samples) and natural stones used as superficial products (about 610 samples).

The total number of samples, as already described in a previous paper (3), is certainly an underestimation. Indeed, in some publications only the activity concentration average values are reported, without specifying the number of samples analysed. In these cases, the value 1 was assigned to the number of samples N. It is important to underline that measurements published in literature and collected in the database were generally performed for radiation protection purposes on samples of materials presumed to be among the most active ones, without claim to be representative at national level. Therefore, these data cannot contribute to elaborate a representative snapshot of building materials in the Europe.

New database

In the report, the data on activity concentrations are organized in 30 tables, one for each country. In each table data are divided into categories of building materials and their constituents, with particular attention to the industrial by-products residues (in italic in the following list), generally called NORM (Naturally occurring Radioactive Material) residues: bricks, concrete, cement, aggregates, tiles, natural raw materials, natural covering stones, ashes (fly and bottom), bauxite residues/red mud, by-product gypsum and metallurgical slag.
Another table presents radon emanation and radon exhalation rate data of about 1500 samples from all countries with available data. Information about sample density and thickness are also reported when present in the relevant reference.
In conclusion, even though the database presented here is not representative of national and EU situations concerning radioactivity in building materials, it is a useful source of information which can support the ALARA process during the practical implementation of the EU BSS (1), in particular in case of recycling in building materials NORM residues from industries. ■

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The 3rd European Radiological Protection Research Week: a feedback (*and the opportunity to present an overview of the CONCERT projects*)

A. SCHMITT-HANNIG

Bundesamt für Strahlenschutz (BfS) – Federal Office for Radiation Protection
85762 Oberschleissheim, GERMANY

Corresponding author: aschmitt-hannig@bfs.de

The 3rd European Radiological Protection Research Week (ERPW3)

The integration of European radiation protection research progresses with the implementation of new EURATOM instruments such as Joint Programming calls supported by research roadmaps and strategic agendas developed by the European radiation protection research platforms. The dynamic of this process requires regular exchanges of research results and new ideas. The European Radiation Protection Research Week (ERPW) is an excellent forum attracting participants from all over Europe and also worldwide to take part in scientific discussions and establish the state of the art in this field.

The third ERPW took place from 1-5 October 2018 in Rovinj, Croatia. It was a great opportunity to further develop personal networks with colleagues from the research community and its stakeholders, and to access prime information. More than 260 participants from 22 European countries as well as from 12 countries outside Europe participated in the conference and 180 abstracts for scientific presentations and posters were submitted.

The European radiation protection platforms focused on specific topics in their field which were deepened in parallel sessions:

MELODI sessions highlighted presentations on

- Shape of the dose response relationship for radiation-induced health effects
- Understanding the health effects of inhomogeneous dose distributions, radiation quality and internal emitters
- New findings in biological and health effects at low doses
- Exploration and definition of the role of genetic and epigenetic modifications in radiation-induced health effects
- identification, development and validation of biomarkers for exposure, early and late effects for cancer or/and non-cancer diseases
- Malta 2018 Radiation Sensitivity Workshop findings

EURAMED sessions focused on

- Radionuclide therapy and uncertainty in internal dosimetry
- Breast radiotherapy and secondary cardiovascular risks
- Optimisation in fluoroscopically-guided interventional procedures and CT
- Radiation induced risks of CT scans

EURADOS concentrated on space dosimetry and various dosimetric and risk calculations and modelling presentations.

ALLIANCE sessions comprised topics such as

- NORM (TENORM) issues for dose assessment / remediation strategies
- Nuclear decommissioning and radioecology

- Challenges for environmental monitoring strategies improving radiological assessment and management
- Effects of ionising radiation at low doses, low dose rates
- Atmospheric releases.

NERIS topics were

- Involvement of residents living in the vicinity of the Chernobyl exclusion zone in monitoring and interpreting measurement results and the influence of individual behaviours
- Novel spectrometry systems for radiological early warning networks in Europe (a summary of METROERM results)
- Challenges of radiological/nuclear on-site measurements
- The importance of mobile units in emergency preparedness and response (mobile units from Croatia and Slovenia shown to the participants received a lot of interest).

Cross-cutting issues such as education and training, ethical aspects and access to infrastructures were also presented

- Educating about radiation risks in high schools: towards improved public understanding of the complexity of low dose radiation health effects
- Thinking beyond the ethics of good intentions: an ethics of care for radiological protection
- Continuous professional development for radiation protection professionals: bringing new scientific insights in practice
- Access to infrastructures: AIR2 and AIR2D Newsletters.

All radiation protection research platforms welcomed the opportunity to hold specific side events during the ERPW in the evenings and during lunch breaks, such as management board and various committee meetings as well as General Assemblies. The MELODI Management Board established new statutes and new internal rules elected the members for the new Executive Council:

- Thomas Jung (Chair, BfS, DE),
- Nathalie Impens (Vice-Chair, SCK-CEN, BE), Fieke Dekkers (Secretary, RIVM, NL),
- Jean-René Jourdain (Treasurer, IRSN, FR), Internal Operations Manager
- (Laure Sabatier, CEA, FR),
- Stakeholder Manager and Communication (Sisko Saaloma, UEF, FI).

Young Scientists Day

The last morning of the ERPW conference was devoted to young scientists. The session was very well attended and altogether 14 presentations were given in different radiation protection areas which all received a lot of attention and applause by the audience.

More details about all presentations can be found in the Abstracts Book of the conference:

https://erpw2018.com/wp-content/uploads/2018/09/ERPW-abstracts-book_web_pages.pdf

CONCERT FUNDED PROJECTS

One day of the ERPW 2018 conference was devoted to the CONCERT Management Board meeting which provided an opportunity for the coordinators of the 9 CONCERT funded projects to give an overview of their research and discuss first results together with the CONCERT partners.

CONFIDENCE (COping with uNcertaintie For Improved modelling and DEcision making in Nuclear emergenCIes); Coordinator: Wolfgang Raskop, KIT, DE + 31 partners

The CONFIDENCE project is performing research on uncertainties in the area of emergency management and post-accident recovery. It concentrates on the early and transition phases of an emergency, but considers also longer-term decisions made during these phases. The work-programme of CONFIDENCE was defined with the objective to understand, reduce and cope with the uncertainty of meteorological and radiological data and their further propagation in decision support systems. This includes atmospheric dispersion, dose estimation, foodchain modelling and countermeasure simulations models. Consideration of social, ethical and communication aspects related to uncertainties is a key aspect of the project. Improvements in modelling and combining simulation with monitoring will help gain a more comprehensive picture of the radiological situation and will clearly improve decision making under uncertainties. Decision making principles and methods will be investigated, ranging from formal decision aiding techniques to simulation based approaches. These will be demonstrated and tested in stakeholder workshops applying the simulation tools developed within CONFIDENCE. A comprehensive education and training programme is fully linked with the research activities.

To date, ensemble modelling for atmospheric dispersion has started; monitoring approaches have been developed and advanced food chain models investigated. Stakeholder panels were set up to investigate the development of sensible countermeasure strategies, define important attributes for decision making and first investigations about mental models (theoretical framework to understand behaviour of people) were performed. Multi-criteria decision tools have been improved for uncertainty handling and first training courses have been prepared [https://eu-neris.net/home/newsletters/171-confidence-training-course-2.html].

LDLensRad (Towards a full mechanistic understanding of low dose radiation induced cataracts); Coordinator: Liz Ainsbury, PHE, UK + 3 partners and 5 supporting organisations

The CONCERT funded LDLensRad project brings together experts from across and beyond Europe to answer key research questions regarding the effects of ionising radiation on the lens, including: the mechanisms involved in low dose radiation induced cataract; the impact of dose and dose rate; the role of age and genetic background, and whether radiation responses observed in the lens can be viewed as global biomarkers of radiosensitivity. The multidisciplinary team of LDLensRad collaborators are investigating the mechanistic chain of events from the biological responses to the initial radiation insult (including intracellular communication and DNA damage and repair), the impact in terms of perturbation of lens fibre formation (including genomic, proteomic, lipidomic and proliferative effects), through to the morphological outcomes in terms of the formation of local cellular changes, protein aggregation and opacities assessed through lifetime cataractogenesis studies. A range of mouse models with different radiosensitivities have been chosen for these studies. The mice are exposed to doses of 0.5 – 2 Gy Co-60 gamma radiation, with dose rates of 0.3 and 0.063 Gy min-1. These studies will be supported by in vitro cellular investigations in a range of appropriate cell lines with a larger number of doses and dose rates. In addition, the potential for a future prospective molecular epidemiology programme using human lenses obtained from workers of the first Russian nuclear facility, the Mayak Production Association, is being explored. These lens biology and cataractogenesis studies are also complemented by neurological and pathological analyses of the brain, and behavioural studies, to consider wider systemic radiation responses and to test the hypothesis that radiation effects in the lens can be used to measure individual radiosensitivity.

Although the project is still at an early stage, initial data already demonstrate the key role of both age at exposure and genetic background in radiation sensitivity of the lens. Interesting trends in dose and dose-rate responses are also beginning to emerge. It is anticipated that the results of this project will have key implications for radiation research and protection. Concrete outcomes are anticipated to include definitive information regarding the shape of the dose and dose-rate responses, in addition to the link between low dose radiation exposure, age and genetic background with respect to cataract and wider systemic effects. The aims and objectives of the project will be presented, together with preliminary data.

TERRITORIES To Enhance unceRtainties Reduction and Stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations) Coordinator: Marie Simon-Cornu, IRSN, FR + 11 partners

The TERRITORIES project targets an integrated and graded management of contaminated territories characterised by long-lasting presence of environmental radioactivity, filling in the needs that emerged after the recent post-Fukushima experience and the publication of International and European Basic Safety Standards. A graded approach, for assessing doses to humans and wildlife and managing long-lasting exposure situations (where radiation protection is mainly managed as existing situations), will be achieved through reducing uncertainties to a level that can be considered fit-for-purpose. This project combines research in sciences supporting radiation protection (such as radioecology, human or ecological dose and risk assessments, social sciences and humanities, etc.), providing methodological guidance, supported by relevant case studies. The overall outcome will constitute the basis to produce novel guidance documents for dose assessment, risk management, and remediation of NORM and radioactively contaminated sites as the consequence of an accident, with due consideration of uncertainties and stakeholder involvement in the decision making process. The results will be widely disseminated to the different stakeholders and accompanied by an education and training programme.

In November 2017 the workshop "Communication of uncertainties of radiological risk assessments to stakeholders" was organised within the education and training activities of TERRITORIES. The aim was to discuss the implications and relevance that the uncertainties in radiological risk assessments in long-lasting exposure situations have for different stakeholders (regulators, industry, scientists and members of the public), and to work out how these uncertainties could be better communicated. The lessons learned in the workshop include an indication of the acceptable level of uncertainty for different stakeholder groups, an overview of how each stakeholder group manages such uncertainties, suggestions of how TERRITORIES can provide guidance on addressing and reducing the most relevant uncertainties for each stakeholder group, the needs and weaknesses of communication of uncertainties for each stakeholder group, and tools and approaches to improve such communication.

ENGAGE (ENhancinG stAkeholder participation in the GovernancE of radiological risks for improved radiation protection and informed decision-making); Coordinator: Catrinel Turcanu, SCK-CEN, BE + 13 partners

ENGAGE is identifying and addressing key challenges and opportunities for stakeholder engagement in relation to three situations of exposure to ionising radiation: medical use of ionising radiation, post-accident exposures; and exposures to indoor radon. To this end, ENGAGE will:

1. answer the questions why, when and how are stakeholders engaged in radiation protection issues;
2. develop novel approaches to analysing stakeholder interaction and engagement and, provide guidance for meeting challenges and opportunities identified;
3. investigate the processes for enhancing radiation protection culture and their role in facilitating stakeholder engagement, and develop guidelines for building radiation protection culture;
4. provide recommendations and build a joint knowledge base for stakeholder engagement in radiation protection.

For mapping the complexity of societal uncertainties in long-term exposure situations, two case studies were conducted: (1) the remediation of a historical NORM contamination (within a mixed contamination), and (2) the remediation of (mixed) contamination resulting from radium extraction.

The analysis allowed for the visualization of the interrelationship between the uncertainties and their causes; including the direction (increase or decrease) of this relationship. The recommendation is made to further map these relationships for other cases and initiate the development of a common conceptual framework representing the complexity of societal uncertainties.

A systematic literature review was conducted on academic literature published in the period 2007-2017 from the database Web of Science. A synthesis analysis is conducted to explore the interpretation given to the term stakeholder and stakeholder engagement. Additionally, this research provides insights in stakeholder rationales for participation (i.e. instrumental, normative and/or substantive), the level of participation and/or model for participation, and the identification of trends, contradictions or divergences to standard practices. In general, it can be seen that concerning legislation and recommendation at international and EU level contradictions in interpretations given to the concept of stakeholder and stakeholder engagement exists. Concerning the motivation for stakeholder engagement a predominant instrumental motivation is identified.

LEU-TRACK (The role of extracellular vesicles in modulating the risk of low-dose radiation-induced leukaemia); Coordinator: Katalin Lumniczky, OKI, HU + 4 partners

The LEU-TRACK project going to study basic mechanisms in low dose radiation-induced leukaemia by focusing on the role of crosstalk between the bone marrow microenvironment and the stem cell compartment in initiating the leukemic process. While radiation-induced direct damage to the haematopoietic stem cell pool is suggested to be the major driver in the development of the disease after higher doses, radiation-induced leukaemia at low doses most probably involves additional mechanisms distinct from those at high doses. Extracellular vesicles (EVs) are major vehicles of intercellular communication due to their complex cargo. The proposal aims to investigate mechanisms and pathways how bone marrow-derived EVs, by influencing the communication between the different cellular components can induce bone marrow damage and thus modulate low dose radiation-induced leukaemia. In order to correlate blood-derived EV markers identified in experimental animals with markers present in human leukaemia patients, a small pilot study, analysing blood-derived EV cargo from leukaemia patients subjected to prophylactic brain irradiation will also be carried out.

The project will provide a better understanding of pathways and/or mechanisms of low dose radiation carcinogenesis and will contribute to a better evaluation of the risks associated with low doses, helping to improve risk perception, disease prevention, health promotion and in the later run therapy development.

PODIUM (Personal Online DosImetry Using computational Methods); Coordinator: Filip Vanhavere, SCK-CEN, BE + 7 partners

The objective of this project is to improve occupational dosimetry by an innovative approach: the development of an online dosimetry application based on computer simulations without the use of physical dosimeters. Operational quantities, protection quantities and radiosensitive organ doses (e.g. eye lens, brain, heart, extremities) will be assessed based on the use of modern technology such as personal tracking devices, flexible individualized phantoms and scanning of geometry set-up. When combined with fast simulation codes, the aim is to perform personal dosimetry in real-time. The objective is to develop an online application in which we will calculate individually the occupational doses, instead of measuring them with one or more dosimeters. For that purpose, the spatio-temporal radiation field, including its energy and angular distribution, needs to be known. Input from fixed dose monitors will be used and real movements of exposed workers and transfer of this data to the calculation application will be captured. Simultaneously, an intermediate approach with pre-calculated fluence to dose conversion coefficients for phantoms of different statures and postures will be used. This approach is the first step towards online dosimetry based on simulations. The methodology will be applied and validated for two situations where improvements in dosimetry are urgently needed: neutron workplaces and interventional radiology.

VERIDIC (Validation and Estimation of Radiation skIn Dose in Interventional Cardiology);

Coordinator: Jérémie Dabin, SCK-CEN, BE + 10 partners

In interventional cardiology (IC), patients may be exposed to high doses to the skin, resulting in tissue reactions, following a single or multiple procedures. To tackle this issue, online and offline software tools have been developed to estimate the maximum skin dose (MSD) to the patient from IC procedures. However, the capabilities and accuracy of such skin dose calculation (SDC) software to estimate MSD and 2D dose distributions markedly differ among software vendors, and the reporting of the MSD estimate and the related accuracy in the radiation dose structured report (RDSR) is neither systematic nor harmonised.

In addition, there is currently no acceptance testing and quality control (QC) protocols of such systems. The VERIDIC project therefore focuses on the harmonisation of the RDSR and on the validation and control of SDC software products in IC, which will foster radiation protection of patients.

SDC software solutions will be analysed according to their calculation algorithms and their capabilities. In particular, the factors considered in the MSD calculation (such as the backscatter radiation, the patient table and mattress attenuation or the patient's body shape) and how they are reported will be investigated. Furthermore, recommendations for harmonising the MSD reporting will be formulated.

Commonly used dosimeters, including Gafchromic films, thermoluminescent detectors as well as dosimeters readily accessible to medical physicists in clinical environment, will be thoroughly characterised for a wide range of conditions encountered in IC. Protocols for acceptance and quality control tests to be used in clinical practice will be developed and tested. Tolerance levels and technical criteria for acceptance of SDC systems will be proposed. Those protocols will also be used for comparing different SDC software.

SEPARATE (Systemic Effects of Partial-body Exposure to Low Radiation Doses); Coordinator: Anna Saran, ENEA, IT + 4 partners

(Background and state of the art in the field of abscopal radiation effects)

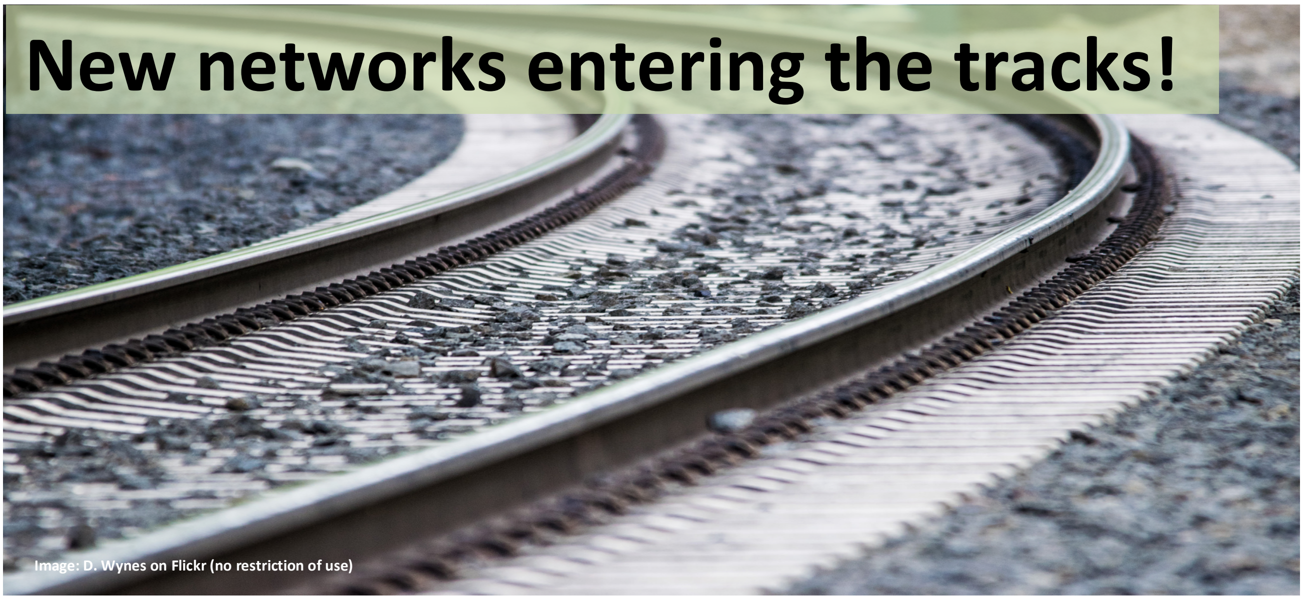
Radiation effects are not confined to directly irradiated tissues. The contribution of systemic "out-of-target" effects to the risk of long-term health problems following radiation exposure is largely unknown. This level of uncertainty of the risk is problematic from the radiation

protection standpoint, as workplace, environmental, and medical exposures frequently involve partial body exposures to low-dose irradiation. SEPARATE aims to address the relevance of out-of-target effects, from those observed after controlled radiation exposure in the laboratory to the dynamic exposure experienced by humans in typical radiation-exposure scenarios, and deliver a detailed mechanistic understanding of the processes governing the associated risks. By focusing on the mechanisms of risk posed by low-dose

Partial body irradiation (PBI), the research programme of SEPARATE specifically addresses several important challenges and long-term goals of the CONCERT low-dose radiation research and radiation protection programme. The work plan is particularly aligned with the MELODI and EURADOS strategic research agendas.

SHAMISEN-SINGS (Involving citizens in dosimetric and health surveillance); Coordinator: Elisabeth Cardis and Liudmila Liutsko + 8 partners and 4 external experts

SHAMISEN-SINGS brings together an experienced multi-disciplinary and multi-national consortium to answer important objectives of the call: to improve countermeasures for nuclear emergency preparedness and provide important knowledge on stakeholder engagement in radiation protection, including a critical assessment of benefits and challenges of citizen science. By taking a practical ethics approach, fostering co-reflection between natural and social scientists, it will strengthen integration of social science in radiation protection. It will also provide an independent channel for collection and management of data for use by authorities for decision making, assessment of doses, evaluation of health/social condition and health surveillance in general, and support in the implementation of BSS.



African ALARA Network (AFAN) is born

J. K. AMOAKO, Secretary of the African ALARA Network

On 5th December 2017 in Antananarivo (Madagascar), the African edition of the ALARA network was formally inaugurated. Mr Jizeng Ma, IAEA Technical Officer for the RAF9057, who was very instrumental in the formation of the network was present to support the meeting. This follows an earlier decision taken during the coordination meeting of RAF9057 in Dakar, Senegal in 2017 to form an ALARA network in the African region to share ideas and exchange information on occupational radiation protection.

Subsequent to the formation of the Network, a team from Member States (MS) and France was constituted as a working group to draft the Terms and Conditions for the Network. The Terms and Conditions which has the initial version in both English and French was circulated to member states for their input. So far 25 member states have join the network. The main objectives of the Network includes:

- To share and exchange information, experience and expertise for promoting the implementation of the ALARA principle for the management of occupational exposure in all situations, in the participating countries.
- To enhance and develop skills and competence in occupational radiation protection for the different stakeholders concerned, in particular through proposals for appropriate training programmes.
- To contribute to the harmonisation of radiation protection policies and practices, particularly concerning ALARA, both at regulatory and operational levels across the region.

Ghana has offered to host the secretariat and website of the network at the RP Institute of the Ghana Atomic Energy Commission. AFAN since its formation has organized one Webinar on the new ISO/IEC 17025 for it members. AFAN hope to collaborate with other Networks with similar objectives in other regions of the world. ■

The IRPA Young Generation Network

The Leadership Committee of the IRPA Young Generation Network

S. ANDRESZ[1] (Chair of the IRPA YGN), A. SAKODA[2] (Secretary), P. BRYANT[3], I. FERNANDEZ[4], T. KONO[2], J. S. KIM[5], W.-H. HA[6], T. HAMIDA[7], F. OTOO[8], J. REVILL[9], V.P. SINGH[10], C. STETTNER[11], I. TSORXE[12]

[1] Nuclear Evaluation Protection Centre (CEPN), FRANCE
[2] Japan Atomic Energy Agency (JAEA), JAPAN
[3] EDF Energy, Nuclear New Build Generation Company, UNITED KINGDOM
[4] University Hospital de Gran Canary, SPAIN
[5] Yonsei University, SOUTH KOREA
[6] Korea Institute of Radiological and Medical Sciences (KIRAMIS), SOUTH KOREA
[7] Tunisian Nuclear Research Centre (CNSTN), TUNISIA
[8] Ghana Atomic Energy Commission (GAEC), GHANA
[9] Rolls-Royce Submarine, UNITED KINGDOM
[10] Narora Atomic Power Station, INDIA
[11] Seibersdorf Laboratories, AUSTRIA
[12] Duke University, UNITED STATES OF AMERICA

Corresponding author: sylvain.andresz@cepn.asso.fr

The International Radiation Protection Association Young Generation Network (IRPA YGN) is an international network of "Young Professionals" across the field of Radiation Protection. Its primary function is to promote communication, collaboration and professional development of students and young professionals in the area of Radiation Protection and its allied fields.

The beginning

The IRPA YGN was proposed at the 13th international IRPA congress in Glasgow (2012), and its formation agreed at the 14th congress in Cape Town (2016).

Membership of the IRPA YGN is open to all members of YGN in national radiation protection societies and, where a national YGN is not in place, students or professionals working within the first 10 years of the career in the field of radiation protection or its allied fields.

In December 2017, the Executive Council of IRPA appointed a Leadership Committee (LC) of a few young professionals. Their primary objectives were to effectively set up the IRPA YGN and drive its growth and development.

Mission

The Leadership Committee developed the following mission statement that will be the "motto" of the IRPA YGN:

> "*To encourage, inspire and develop the next generation of radiation protection professionals across the world and promote the communication and collaboration of our members*"

Objectives

Underpinning its mission are the following core objectives:

1. Attracting individuals into the field of Radiation Protection, by engaging and

inspiring them early in their career journeys.

2. Enable the development of students and young professionals studying / working in the field of Radiation Protection by providing valuable personal and professional development and growth opportunities.
3. Providing a supportive and growing community, promoting communication and collaboration to help retain young professionals working in the field of Radiation Protection.
4. Improve the understanding of Radiation Protection and its allied fields across the world by being ambassadors for the field.

Beginning 2018, the IRPA YGN ran an international competition for the design of its logo. The proposition from the French Society for Radiation Protection (SFRP) won the competition and was presented with an award at the IRPA Regional Congress in the Hague (June 2018).

Official launch at IRPA Regional Congresses in 2018

The IRPA YGN was officially launched at the IRPA Regional Congresses that took place in 2018:

- At the IRPACUBA 2018, La Habana, 16-20 April.
- The 5th Asian & Oceanic IRPA Congress on Radiation Protection (AOCRP), Melbourne, 20-23 May.
- 5th IRPA-Europe, The Hague, 4-8 June.
- 5th African IRPA Congress (AFRIRPA), Tunis, 6-9 September.
- The IRPA YGN was also presented at the 51th annual meeting of the Japan Health Physics Society in Sapporo in 29-30 June.

The launch events took the shape of a specific young professional's session, within the programme of the congresses and promoted as such. The launch events would not have been possible without the involvement of several of the concerned Programme Committee members and the Leadership Committee, and we would like to reiterate our thanks to these individuals.

The launch events presented the opportunity for several representatives of the regional IRPA's Associated Societies YGN ("national YGN") to meet and discuss about their structures, activities and perspectives. For example, in AOCRP-5, representatives from Japan, South Korea, China and Australia presented the work of their national YGNs; at The Hague, representatives from Italy, Spain, Austria, France and United Kingdom presented about the work of their YGNs and discussed common issues and successes during a round table debate. The keynotes from these two sessions are available on the IRPA YGN web-section of the IRPA website[1].

Moving forward: a Strategic Agenda

After the launch, the Leadership Committee(LC) has extended and now includes 11 young professionals, from different backgrounds and countries. The IRPA YGN LC is in contact with the national YGN (or equivalent) in 27 countries.

The Leadership Committee recently completed a Strategic Agenda for the 2018-2020 period. The Strategic Agenda aims to drive the growth of the IRPA YGN, in line with its Mission and Objectives, and also give priority to the specific challenges faced by the young professionals and scientists in radiation protection and its allied fields. These challenges have been identified from two sources;

- The analysis of the results of an international survey specifically targeted at the young generation in radiation protection

[1] http://www.irpa.net/irpa_mini.asp?site=YPN/index.asp

that run in 2017[2],
- and also from the synthesis of the launch events.

For example, one outcome of the launch events is that the national YGNs share common goals and have invested in addressing similar issues – although in a different manner sometimes. Because the national YGNs have worked separately so far, we would like to encourage visibility around what the national YGNs do and encourage knowledge exchanges and experience transfer between them. A particular focus in the Agenda is also given to overriding issues such as training and professional development, which is particularly at stake in the first years: it is often reported that Radiation Protection is a learn 'on the job' field and this is regarded as very difficult. We also would like to attract the younger generation in the field of Radiation Protection (e.g. by encouraging visibility of the careers in the sector) and, more generally, we would like to encourage communication, so to create interest and emulation between YGNs.

Perspectives

2018 was a major milestone for IRPA YGN (hence also for IRPA itself!) with the first actions initiated, the launch events all over the world and the drafting of the Strategic Agenda.

But next comes the difficult part: keeping the momentum going. We need to expand our coverage with the aim of representing as many countries as possible and gathering the forces and enthusiasm of young professionals and scientists of the IRPA Associated Societies.

But a sustainable growth cannot be achieved if the IRPA YGN works alone: we would therefore like to establish relationships and build support with the IRPA Executive Council, the IRPA Associated Societies and also other organisations that have an interest in the young generation.

Our next milestone is the IRPA-15 international congress at Seoul in May 2020. ■

[2] All the results of the survey are available at https://tabsoft.co/2laIFEO

ALARA News

EAN at the 2nd SFRP-IRPA workshop on the "reasonableness" 23-24 October 2018, Paris

S. ANDRESZ[1], F. VERMEERSCH[2]

[1] Nuclear Evaluation Protection Centre (CEPN), FRANCE
[2] SCK•CEN Mol, BELGIUM

Participants to the 2nd SFRP-IRPA Workshop of reasonableness

The optimisation principle is the cornerstone of the Radiological Protection system. However, it is recognized that the "reasonable" level of protection according to the ALARA principle is not easy to demonstrate. Taking into account the benefit of feedback from different countries and complementing IRPA's reflection in the 2016 IRPA letter on the evolution of the RP system, SFRP proposed an initiative on the search for reasonableness.

Background

A first workshop was organised in Paris on 23-24 February 2017 (cf. EAN Newsletter n°39). Several attendees, from European, Japanese and Korean RP Societies, and International Organisations (IRPA, ICRP, NEA, WHO, EAN) shared their experience.
The objectives of the first workshop were to review the foundation of the optimisation principle (ICRP system, ethical dimensions, ALARA culture) and examine the practical implementation of this principle in 3 sectors: nuclear, medicine, existing exposure situations (radon, radium, post-accident). The participants tried to answer the question: how low is low enough?

The main conclusions of the first workshop were that in all sectors, optimisation remains a challenge and that optimisation is a deliberate process to achieve a reasonable "compromise" with all (informed) stakeholders. The synthesis of the first workshop was published in *Radioprotection* (2017, Vol 52, n°4).

The 2nd workshop objectives

With the second workshop (around 30 participants), the objective was to show how the search for reasonableness could be practically done through **continuous dialogue**. The workshop was first devoted to presentation of case studies:

- Related to public, occupational and patient exposure (e.g. discharges, waste, legacies, medical procedures);
- In the 3 sectors (nuclear, medical, existing exposure situations);
- Showing the involvement of stakeholders including capacity building.

A short synthesis

In the nuclear sector, the French utility EDF and Comex – a contractor, presented the building of an efficient relationship, with strong interfaces at different levels of the organization. This has lead to a continuous reduction during the years in the dosimetric exposure received during the replacement of the heating system for pressurizer on the EDF' plants fleet. In the nuclear sector, dialogue and engagement between the client and the contractors is often formalized in contracts, written procedures and an ALARA programme that engages the hierarchy from bottom to top (this was also illustrated in the Spanish presentation). Collect of feedback experience and education are common.

The UK SRP's keynote showed, with several examples, how regulation can set the tone in the quest of reasonableness and how conservatism may lead to the minimization of the exposure with 'gross disproportion', and calling for improving the dialogue between operators and regulators.

In the medical sector, two successful collaborative processes in Quebec and Konstantopoulio hospital, Greece, notably one involving a dedicated team of multi-disciplinary experts traveling from hospital to hospital to outreach radiation protection (experience from Quebec) also leads to global dosimetric achievement. But the questions on how to assess the involvement of individuals (e.g. practitioners) in ALARA and how to ensure this involvement is sustainable remain unsolved. Also in the medical field, dose reduction is achieved with the help of concrete tools and technique; an algorithm to optimize CT-image by balancing the noise and the exposure was presented by the Italian representatives. The concept of ALADA (Diagnosticable) principle was introduced. It was also reported that emulation between manufacturers drives the design of devices with limited exposure.

Ethical and societal aspects are the most at stake in existing exposure situations because local stakeholders: members of the public, professionals, health authorities etc. - generally not aware of radioactivity and radiation protection - need to be involved in some manner in the optimisation process. This is done on a case-by-case basis, depending on the circumstances, and the experiences from the Radium Action Plan in Switzerland and the management of radon in Czech Republic were presented. Four keys questions that shape the dialogue (or prevent it) between radiation protection experts and the local stakeholders can be identified:

- the numerical values (of exposure), noting there is a focus on the 1 mSv/y value, and their meaning(s) (comparison with other risk is possible but to be made with caution);
- the importance of the economic factors,
- the ownership of both the responsibilities and the leadership in the process;
- and the link of the radiation protection initiatives with the overall quality of life.

During the two days, time has been devoted to discussions in working groups (one working group for each sector) to investigate the topics more deeply.

SFRP has published the videos taken during the workshop on its YouTube channel[3]. It is also planned to disseminate the conclusion and the synthesis of the workshop. ■

[3] https://www.youtube.com/watch?v=FhW8_s2RiC8&list=PL57vZeQzRG22fjttoL3n7aLUT3c8sUgGj

EAN 19th workshop

The EAN will organise it's 19th workshop on the topic of **ALARA Tools for the end of 2019**. Provisional objectives are:

- To present recent and emerging innovative "ALARA Tools" that apply in the different steps of the ALARA process.
- In particular, help in the dissemination of the **PODIUM** project's ALARA tools on the optimization of occupational exposure via personal dosimetry using computational methods.
- To investigate the benefits of these innovative tools for ALARA, and also identify potential limits and obstacles.
- Explore more broadly how innovative ALARA tools and the innovation may (re)shape the ALARA process for the next years: ALARA, toward a (r)evolution?

The local organisation will be taken care of by the Greek Atomic Energy Commission (EEAC, Member of EAN). Provisional date and place are **Athens in December 2019**. We will keep our Readers updated about location, date and content. ■

Next EUTERP Workshop

The EUTERP Foundation is recognised as the focus for radiation protection training information for RPE, RPO and radiation workers.

The EUTERP Foundation will run its 8th workshop on Optimising Radiation Protection Training from 10-12 April 2019 at Qawra, Malta.
The following topics will be covered:

- Radiation protection trainer "standards"
- Guidance on Train-The-Trainer approach
- Course design, evaluation and recognition
- Standards for worker training

The abstract deadline is 21 December 2018. Registration website is open.
http://academy.sckcen.be/en/Events/EUTERP-workshop--Optimising-Radiation-Protection-Training-20190410-20190412-99fa493d0868e81180cbecf4

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FAQ ALARA – Quiz yourself

A little bit of history

1. **Who discovered X-rays?**
(a) Wilhelm Röntgen
(b) Henri Bequerel,
(c) Marie Curie,
(d) Irène Curie

2. **In 1921, A. Einstein received the Nobel Prize in Physics for an article published in 1905. The topic of this article was**
(a) the theory of relativity
(b) the photo-electric effect
(c) the Brownian motion
(d) the equivalence mass-energy ($E= mc^2$)

3. **How many Nobel Prizes did the Curie family received?**
(a) 2
(b) 3
(c) 4
(d) 5

4. **By the way, what was the first name of Marie Curie?**
(a) Curie (she did not change her name after her marriage)
(b) Sklodowska,
(c) Sancellemoz,
(d) Wladyslaw

5. **Who discovered the neutron in 1932?**
(a) James Chadwick (Nobel Prize 1935)
(b) Carl David Anderson (Nobel Prize 1936)
(c) Enrico Fermi (Nobel Prize 1938),
(d) Enrico Fermi (but he received the Nobel Prize in 1939).

6. **Rolf Sievert (1896 – 1966) was**
(a) Norwegian
(b) Swedish
(c) He received the American citizenship at the end of his life
(d) Vegetarian

1. (a), 2. (b), 3. (d), 4. (b), 5. (a), 6. (b)

* *
*

Contacts

European ALARA Network Contact Persons

AUSTRIA
Alfred HEFNER
Seibersdorf Laboratories GmbH
2444 SEIBERSDORF
Tel: +43 50550 2509; Fax: +43 50550 3033
E-mail: alfred.hefner@seibersdorf-laboratories.at

BELGIQUE
Fernand VERMEERSCH
SCK•CEN
Boeretang 200, 2400 MOL
Tel: +32 14 33 28 53; Fax: +32 14 32 16 24
E-mail: fvermeer@sckcen.be

CROATIA
Mladen NOVAKOVIC
Radiation Protection Autjority – EKOTEH Dosimetry
Vladimira Ruzdjaka 21, 10000 ZAGREB
Tel: +385 1 604 3882; Fax: +385 1 604 3866
E-mail: mlnovako@inet.hr

CZECH REPUBLIC
Jan KROPACEK
State Office for Nuclear Safety,
Syllabova 21, 730 00 OSTRAVA
Tel: +420 596 782 935; Fax: +420 596 782 934
E-mail: jan.kropacek@sujb.cz

DENMARK
Kresten BREDDAM
National Institute for Radiation Protection
Knapholm 7, 2730 HERLEV
Tel: +45 44 54 34 63
E-mail: krb@sis.dk

FINLAND
Maaret LEHTINEN
Säteilyturvakeskus – Radiation Practices Regulation
Laippatie 4, 00880 HELSINKI
Tel: +358 9 75988244 Fax: +358 9 75988248
E-mail: maaret.lehtinen@stuk.fi

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ISSN 1270-9441
c/o CEPN
28, rue de la Redoute
F-92260 Fontenay-aux-Roses
http://www.eu-alara.net

FRANCE
Paul LIVOLSI
Institut National des Sciences et Techniques Nucléaire, Commissariat à l'Energie Atomique (CEA/INSTN),
17 rue des Martyrs 38054 GRENOBLE Cedex 9
Tel: +33 4 38 78 39 27; Fax: +33 4 38 78 51 01
E-mail: paul.livolsi@cea.fr

NORWAY

GERMANY
Annemarie SCHMITT-HANNIG
Bundesamt für Strahlenschutz,
Ingolstädter Landstrasse 1, 85764 OBERSCHLEISSHEIM
Tel: +49 3018 333 2110; Fax: +49 3018 10 333 2115
E-mail: aschmitt-hannig@bfs.de

PORTUGAL

GREECE
Sotirios ECONOMIDES
Greek Atomic Energy Commission
P.O. Box 60228, 15310 AG-PARASKEVI
Tel: +30 210 6506767; Fax: +30 210 6506748
E-mail: sikonom@eeae.gr

SLOVENIA
Dejan ŽONTAR
Slovenian Radiation Protection Administration
Langusova 4, 1000 LJUBLJANA
Tel: +386 1 478 8710; Fax: +386 1 478 8715
E-mail: dejan.zontar@gov.si

ICELAND
Guðlaugur EINARSSON
Geislavarnir Ríkisins
Rauðararstigur 10, 150 REYKJAVIK
Tel: +354 552 8200; Fax: +345 552 8202
E-mail: ge@gr.is

SPAIN
Arturo PEREZ MULAS
Consejo de Seguridad Nuclear
Justo Dorado 11, 28040 MADRID
Tel: +34 91 346 02 62; Fax: +34 91 346 03 16
E-mail: apm@csn.es

IRELAND
Hugh SYNNOTT
Environmental Protection Agency,
Office of Radiological Protection
3 Clonskeagh Square, Clonskeagh Road, DUBLIN 14
Tel: +353 1 206 69 46; Fax: +353 1 260 57 97
E-mail: hsynnott@epa.ie

SWEDEN
Camilla LARSSON
Stralsäkerhetsmyndigheten,
17116 STOCKHOLM
Tel: +46 8 799 44 33
E-mail: camilla.larsson@ssm.se

ITALY
Cristina NUCCETELLI
Istuto Superiore di Sanità – Technology and Health Department
Viale Regina Elena 299, 00161 ROME
Tel: + 39 06 4990 2203; Fax: +39 06 4990 2137
E-mail: cristina.nuccetelli@iss.it

SWITZERLAND
Nicolas STRITT
Swiss Federal Office of Public Health,
Radiation Protection Division,
3003 BERN
Tel: +41 31 324 05 88; Fax: +41 31 322 83 83
E-mail: nicolas.stritt@bag.admin.ch

UNITED KINGDOM
Julie GILCHRIST
Public Health England – Centre for Radiation, Chemical and Environmental Hazards, Chilton
DIDCOT – OX11 0RQ
Tel: +44 1235 825301
E-mail: julie.gilchrist@phe.gov.uk