TRAINING COURSE ON CALIBRATION OF RADIATION PROTECTION MONITORS. AN EXAMPLE OF COLLABORATION BETWEEN PROFESSIONAL SOCIETIES, METROLOGY EXPERTS AND RADIATION PROTECTION PRACTITIONERS

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ABSTRACT

The Spanish Radiation Protection Association (SEPR) is a non-profit professional organisation that supports the scientific promotion and dissemination of personal and environmental radiation protection against ionizing and non-ionizing radiation. The organisation of training courses is one of its key activities. Thanks to the multidisciplinary background of its members, the SEPR is well suited to promote networking and collaboration between experts and practitioners.

One of the latest initiatives was the organisation of a 2.5 days training course on the calibration of radiological protection equipment. The course has been organized twice by the SEPR in collaboration with the three Spanish metrology laboratories in the field of radiation protection: CIEMAT (Madrid), CND (Valencia), and UPC (Barcelona).

The aim of the course is to introduce the basic concepts of ionizing radiation metrology and provide the necessary tools to understand and correctly use the calibration certificates of radiation protection detectors. Particular emphasis is placed on the theoretical presentation and practical application of the calibration procedures of personal dosemeters, portable and area monitors for environmental monitoring, and surface contamination monitors, as well as the application of the "Guide for the expression of Measurement uncertainty" (GUM). In addition, the course allows attendees to have a better knowledge of the metrology facilities in Spain and the available instrumentation. It includes a visit to the premises of the host calibration laboratory, as well as case study discussions in small groups.

1. Introduction

Monitoring of the individual exposure of workers and of the workplaces constitutes an essential requirement of any radiation protection programme [1, 2]. Radiation monitoring instruments used for quantitative radiation measurements are needed for the assessment of occupational doses in practices and in emergencies, for the application of the ALARA principle and to prove compliance with radiation protection regulation. To ensure the reliability of these measurements, the equipment needs to be properly calibrated.

The Spanish Radiation Protection Association (SEPR) is a non-profit professional organisation that supports the scientific promotion and dissemination of personal and environmental radiation protection against ionizing and non-ionizing radiation. The organisation of training courses is one of its key activities. Thanks to the multidisciplinary background of its members, the SEPR undertook the organisation of a series of practical courses on *Calibration of radiation protection monitors* with the collaboration of the national calibration laboratory, CIEMAT (Madrid), and of the two accredited laboratories in this field, CND (Valencia) and UPC (Barcelona).

The courses were planned to respond to an expression of interest from the SEPR members in an opinion survey at the end of the year 2015.

2. Scope

The aim of the course is to introduce the basic concepts of ionizing radiation metrology and provide the necessary tools to understand and correctly use the calibration certificates of radiation protection monitors. It is aimed at professionals of the different types of application of ionizing radiation. It is particularly suitable for those who have already experience as radiation protection advisers and want to strengthen their knowledge in metrology, especially in the correct interpretation of their radiation protection measurements.

2.1 Venue and facilities

The first edition of the course was held in September 2016 in Barcelona (North East of Spain), at the premises of the Calibration Laboratory of the UPC. The participants had the opportunity to visit the facilities for X-rays, gamma and beta calibration, as well as the laboratory for calibration of superficial contamination monitors. An example of calibration was shown to highlight how the instruments are used, to familiarize participants with the typical secondary standards as well as with the different types of phantoms used for the calibration of personal dosemeters.

The second edition was organized in April 2017 in Madrid at the National Calibration Laboratory of Ionizing Radiation. Besides visiting the gamma and beta calibration facility, participants were also invited to visit the neutron facility. At the end of 2017 a new edition is planned in Valencia.

The course material and the lecturers who teach in the different editions are usually the same. But, organizing courses in three different labs located in different areas of Spain has two main advantages: on the one hand, the movement of participants and, on the other hand, the chance to visit several facilities.

2.2 Attendees

The number of attendees was limited to 26 people to ensure high interaction between experts and participants and allow the set-up of small groups for the case studies and the visit. The first edition was attended by 26 people, 78% of which were SEPR members. Participants came from different fields: 23% medicine and public health, 35% research and teaching, 19% industry and energy, 8% technical and commercial activities, and 15% regulatory body. As expected, most of the participants (50%) came from Eastern Spain, area

close to the venue, 42% from Madrid and central area, 4% Southern Spain and 4% Northern Spain.

The second edition was attended by 21 people, 48% of which were SEPR members. Participants came from different fields: 24% medicine and public health, 19% research and teaching, 14% industry and energy, 24% technical and commercial activities, and 19% regulatory body. As expected, the most important changes were related to the origin of the participants. In this case, most of them (81%) came from Madrid and central area, 9.5% from Eastern Spain and 9.5% from the Northern area.

3. Course outline

The course is structured into four theoretical background sessions dealing with:

1. Introduction: metrology basic concepts and objectives; radiation protection quantities, Standards.
2. Radiation protection instruments: personal dosemeters, portable and area monitors, surface contamination monitors.
3. Calculation of uncertainty: basic concepts, methods for the statement of uncertainties in measurements, the "Guide for the expression of Measurement uncertainty" (GUM) [3], examples.
4. Calibration procedures: description of procedures using external beams (X-ray, gamma and beta), secondary standards, chain of traceability, calibration of contamination monitors, calibration phantoms for personal dosemeters, determination of the calibration factor, example of calibration certificates.

It includes as well the discussion about three realistic practical cases, analysed in small groups of 8 people and coordinated by a responsible of one of each of the calibration laboratories. From the data collected in calibrations of different types of measurement, the participants are asked to prepare a calibration certificate, determining the calibration factor and the associated measurement uncertainty. The examples include the calibration of:

1. Portable ionization chamber in units of $H^*(10)$ using ^{137}Cs external beams.
2. Electronic personal dosemeter in units of $H_p(10)$ and $H_p(0.07)$ using ISO x-Ray narrow series beams [4].
3. Portable surface contamination monitor in units of Bq/cm^2 using 10 cm x 10 cm reference beta sources.

The discussions are very useful to clarify and illustrate the theoretical presentations and to solve specific problems or issues raised by participants. Moreover, guidance about whether a particular radiation monitoring instrument is adequate for its intended use and assessment about the most suitable calibration procedure for this use are given.

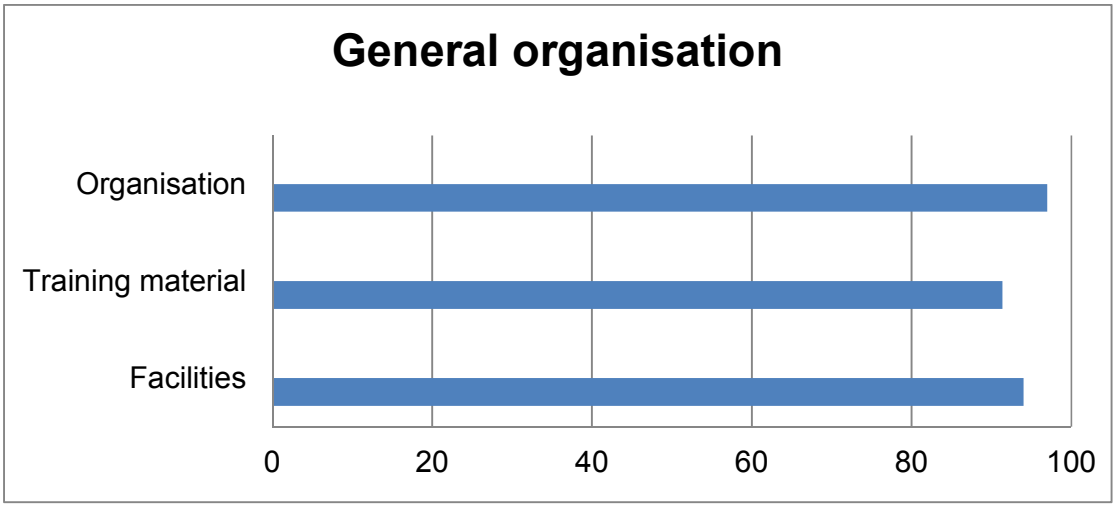
As indicated in paragraph 2, the course includes a visit to the premises of the host calibration laboratory.

A comprehensive course booklet and a certificate of attendance are provided.

4. Participants' feedback

At the end of the course, a questionnaire was distributed to the participants. They were asked to provide views and comments as regards general organisation, facilities and equipment, training material, lecturers, their interest in the course and a final general grade. The quantitative answers were graded as 100% very positive, 67 % good-positive, 33% needs improvement, 0% negative.

As an example, a summary of the results of the first edition is presented in percentage form, following the numerical criteria specified above.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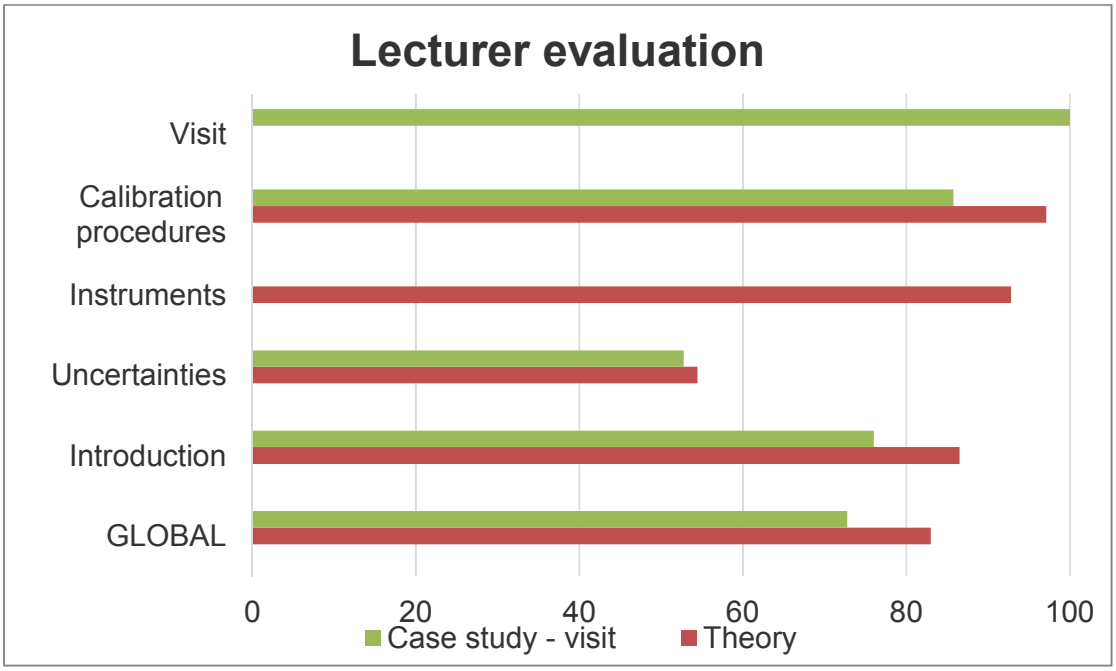
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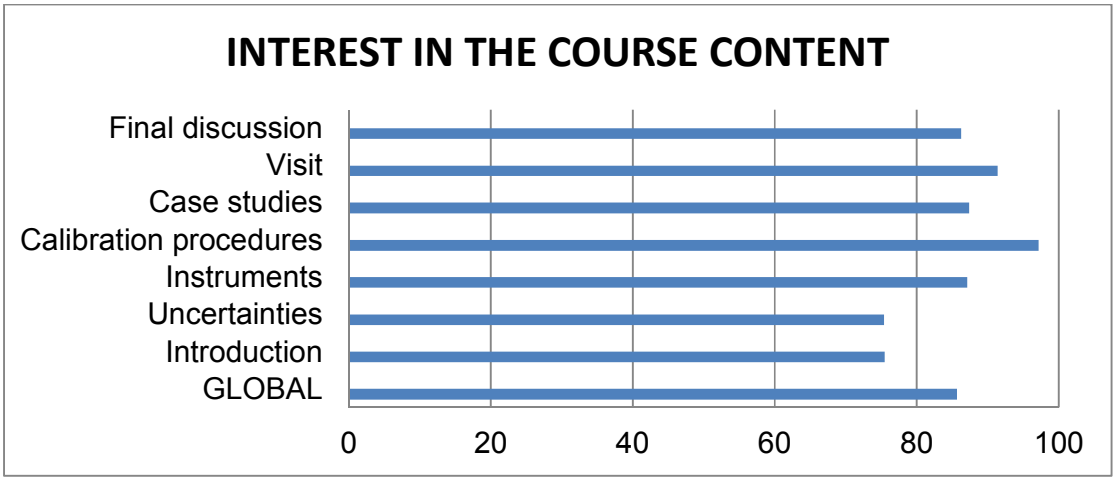
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Most of the parameters were evaluated as very positive, generally exceeding 80%. The topic about uncertainty calculation obtained a score around 50%. Several comments about it indicated that it was found to be too theoretical and participants suggested it could be improved by simplifying the content and introducing more simple examples.

There were also some suggestions about increasing the time assigned for the case study sessions and for the visits and this was introduced in the second edition, which is now under evaluation.

5. Conclusions

The feedback and interest of participants have been very satisfactory. They have particularly appreciated the discussion of the case studies, the wide experience of the lecturers and the possibility to visit the calibration facilities.

This course is an example of collaboration between organisations. The SEPR, as other Radiation Protection Associations, is an excellent platform to contribute generating networking between peers, to promote training in the field, to identify education and training needs and to propose solutions focused on the needs.

6. References

[1].ICRP Publication 103. *The 2007 Recommendations of the International Commission on Radiological Protection*. Ann. ICRP, 37 (2-4), 2007.

[2].IAEA Safety Standards Series No. GSR Part 3 *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards.* ISBN, 978-92-0-135310-82014, 2014.

[3].ISO/IEC Guide 98-3:2008 – *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995),* 2008.

[4] ISO 4037-1*, X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy -- Part 1: Radiation characteristics and production methods*, 1999.