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Replicate calibrations using the same method as one of the ways to ensure the validity of the results of the laboratory calibrating ionization chambers for radiotherapy centers in Poland

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*** an actual scope of accreditation No. AP 155 is available on the PCA website: www.pca.gov.pl**

Introduction

According to section 7.7.1 of the ISO/IEC 17025:2017 standard [1], accredited calibration laboratory shall have a procedure for **monitoring the validity of results**.
This monitoring shall be planned and **reviewed** and **shall include**, but not be limited to **replicate calibrations using the same method**.

And according to section 7.7.3 of the standard [1] **data from monitoring activities shall be analysed and used to both control and improve the laboratory's activities**.

These requirements are crucial in any calibration field, but especially in the field of calibration of ionization chambers used in dosimetry for radiation therapy centers.

Introduction

In this work, we will present the ways of implementing the aforementioned requirements of the ISO/IEC 17025:2017 standard [1] at the Secondary Standards Dosimetry Laboratory in Warsaw in Poland accredited by the Polish Centre of Accreditation (accreditation No. AP 155).

Note: The accreditation No. AP 155 granted on 28 May, 2014 covers the **calibration of ionization chambers together with electrometers in a ^{60}Co gamma ray beam in terms of dose absorbed to water and calibration of well chambers with a ^{192}Ir source in terms of air kerma**. The Polish SSDL performs its laboratory activities in the aforementioned accreditation scope for radiotherapy centers in Poland.

In particular, we will discuss the content of the procedure we have developed. In addition, we will highlight the most important aspects of replicate calibrations, such as the establishment of acceptance criteria for results from repeated calibrations.

Finally, we will give some results from the routine activities of our laboratory and analyze these results according to the dispositions in our procedure.

Methods

Recording and reporting replicate calibrations in practice:

At the Polish SSDL, meeting the requirements of the ISO/IEC 17025:2017 standard regarding monitoring the validity of results is described in the established **procedure:**

„Ensuring the validity of results”.

The subject of the procedure is **external and internal undertakings** to ensure the monitoring of the validity of the results of laboratory activities being within the scope of accreditation for compliance with the requirements of PN-EN ISO/IEC 17025.

Examples of external undertakings:

- participation in proficiency testing (PT);
- participation in interlaboratory comparisons (ILCs) other than proficiency testing.

Examples of internal undertakings:

- intermediate checks on measuring equipment;
- visual check of the equipment which is not a measuring instrument;
- metrological control of an additional measuring equipment (i.e. thermometers, barometers, hygrometers);
- replicate calibrations using the same method.

Methods

Recording and reporting replicate calibrations in practice:

Our procedure: „Ensuring the validity of results" includes the **following forms** for documenting activities concerning internal undertakings:

- ✓ Form No. 6: „**Schedule for monitoring the validity of calibration results"**;
- ✓ Form No. 7: **„Review of the schedule for monitoring the validity of calibration results";**
- ✓ Form No. 8: **„Report on activities to monitor the validity of calibration results";**
- ✓ Form No. 9: **„Register of reports on the activity of monitoring the validity of test / calibration results";**
- ✓ Form No. 10: „**Tracking the direction of change of data from monitoring the validity of calibration results".**

Methods

Recording and reporting replicate calibrations in practice:

In the form No. 6: „Schedule for monitoring the validity of calibration results” Head of the Polish SSDL establishes the following aspects:

- SSDL personnel assigned to perform activities to monitor the validity of calibration results, i.e. ;
- activities to monitor the validity of calibration results, which should include, if appropriate, at least:
  - use of alternative equipment that has been calibrated to ensure the measurement consistency of the results;
  - verification(s) of the performance of measurement equipment
  - intermediate checks of measuring equipment;
  - replicate calibrations using the same or other methods;
  - retesting or calibration of stored objects;
  - review of the results obtained;
  - intra-laboratory comparisons;
- planned date of implementation of activities to monitor the validity of calibration results covering the current accreditation cycle (the minimum frequency of activities is 1 time per accreditation cycle for each sub-discipline);
- criterion for acceptance of data analysis results from monitoring the validity of calibration results.

Methods

Recording and reporting replicate calibrations in practice:

In the form No. 6: „Schedule for monitoring the validity of calibration results” Head of the Polish SSDL establishes the **following aspects concerning replicate calibrations**:

- calibration of the same calibration object should be performed by **different members of the SSDL staff** in accordance with the currently **valid calibration instruction being within the scope of accreditation No. AP 155**;
- **frequency**: during the periodic comparison between SSDL staff - at least once for each calibration method until the end of the respective accreditation cycle;
- **acceptance criterion**: the quotient, expressed as a percentage, of the value of the calibration factor *N* determined by employee 1 and the value of the calibration factor *N* determined by employee 2 should be **in the range ⟨99.0%;101.0%⟩**.

Methods

Recording and reporting replicate calibrations in practice:

The completed form **No. 6 „Schedule for monitoring the validity of calibration results" is reviewed by the Head of the Polish SSDL or his deputy at least once a year** (at least every 12 months) **for its actuality** - especially in case of changes regarding measuring instruments, measuring equipment, personnel performing calibrations and calibration method.

Records of the review are made by the Head of the Polish SSDL or his deputy on the **form No. 7** „**Review of the schedule for monitoring the validity of calibration results**".

Note: If the schedule is considered invalid, the Head of the Polish SSDL or his deputy prepares a new schedule on the form No. 6.

Based on the current schedule of activities to monitor the validity of calibration results, the staff of the Polish SSDL performs the scheduled activities and prepares records of these activities on the form **No. 8 „Report on activities to monitor the validity of calibration results"**.

Exemplary results

Results of the calibration of ionization chamber together with electrometer in a ^{60}Co gamma ray beam in terms of dose absorbed to water

Parameter	Employee 1 (called MS)	Employee 2 (called WSK)
	Calibration date: 04 January, 2023	Calibration date: 05 January, 2023
$N_{D,w} \pm U(N_{D,w})$ [cGy/nC] *	**5.389 ± 0.079 ***	**5.392 ± 0.079 ***
$N_{D,w}^{\text{Employee 1}} / N_{D,w}^{\text{Employee 2}}$ [%]	**99.9**	

Parameter	Employee 1 (called WSK)	Employee 2 (called IG)
	Calibration date: 05 January, 2023	Calibration date: 10 January, 2023
$N_{D,w} \pm U(N_{D,w})$ [cGy/nC] *	**5.392 ± 0.079 ***	**5.388 ± 0.079 ***
$N_{D,w}^{\text{Employee 1}} / N_{D,w}^{\text{Employee 2}}$ [%]	**100.1**	

* Result in the scope of accreditation No. AP 155

Analysis of the results:

The results met the predetermined acceptance criterion.

Conclusions

Practical examples presented in this work, concerning replicate calibrations using the same method can be useful to other calibration laboratories and, with minor modifications, can undoubtedly be applied to many areas of calibration as one of the ways to ensure the validity of the results.

References

1. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, General requirements for the competence of testing and calibration laboratories, ISO/IEC 17025:2017, ISO, Geneva (2017).

Thank you for your attention.