Maintenance of Equipment

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Joint IAEA and ICTP Workshop on Reference Dosimetry in External Beam Radiotherapy and Brachytherapy

Dates: 03 to 07 November 2025

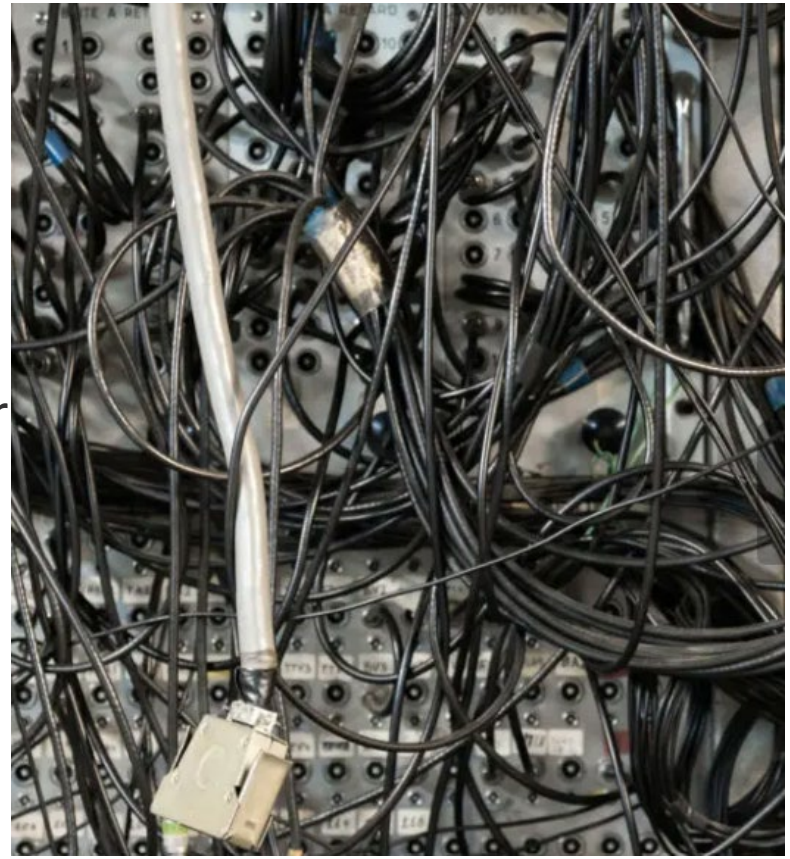
Location: ICTP

Introduction

- You come to a new institute and you have to do measurements and you find connections like …

OR

- As a person responsible for performing measurements in bunker A and you have been meticulous about maintaining your instruments, and how you perform measurements etc. It happens you have to be out of office for a prolonged period and someone has to come and do the tasks that you were doing. When you come back you find your cables intertwined and settings on measurement devices changed.



- Would you trust the data that was done in your absence?
- How can this be avoided?

Quality management system

- Quality management system is not the monster that it may be perceived to be
- It helps to ensure things are done consistently and makes life easy for everyone to know what the previous person did to help you also perform the tasks especially when there is no handover
- Never think its common sense and assume the next person will know how you did it
- What is important needs to be documented even how you pack equipment for calibration
- Risk based thinking in establishing your QMS and focussing on risks that will really have bigger impact and invest in minimising the risk as much as possible

What is correct with these packages?

- This is equipment received/ sent to/by SSDLs for calibration

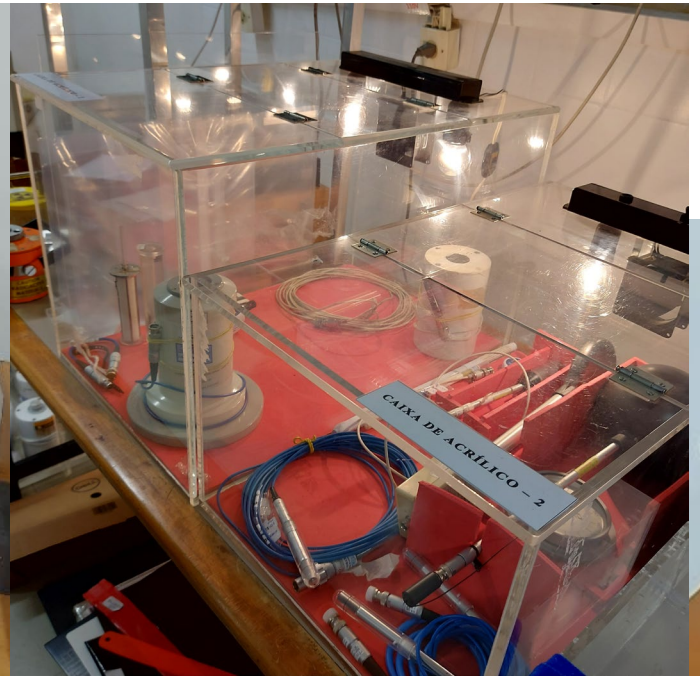
- What are the risks associated with shipment of your equipment?
- When you understand these risks, you will pack differently

Storage of the chambers

- What could be the effect of this small powder to the ionisation chamber?
  - Connectors?
  - Powder getting into the chamber cavity?

Storage of chambers and electrometers

- Know your environmental conditions and put in measures to protect your equipment
- Dust may impact instruments



Maintenance

- Never try to repair chambers and connectors on your own unless you have a specialist who has been trained to do this
- The characteristics of the chamber might change
- Do not use tape or super glue
- Best is to send to a company specialising in these e.g. manufacturer

Maintenance plan including budget

“maintenance plan is needed to ensure the sustainability and functioning of the lab/department”

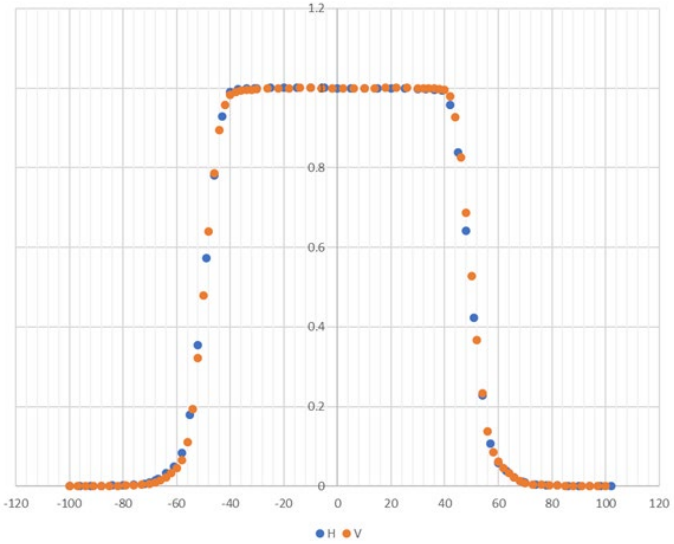
For example;

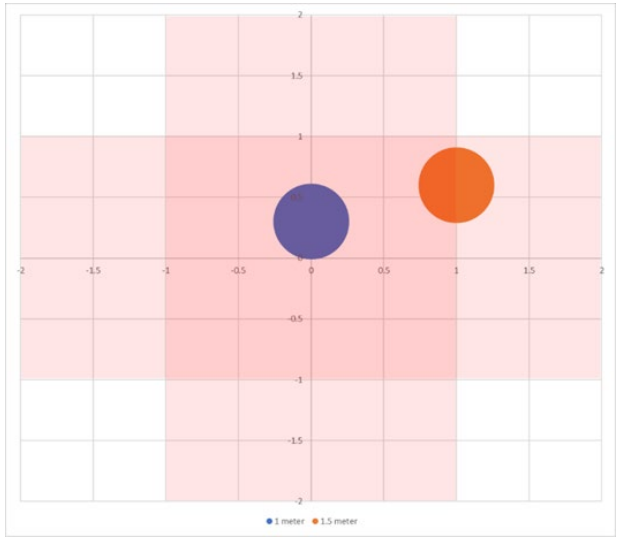
- renewing software licences,
- maintaining the IT infrastructure,
- air conditioning systems,
- Safety and security equipment,
- Radiation protection equipment (interlocks, radiation monitors, etc.),
- Calibration benches

Irradiation units and positioning systems

Periodically check;

- Beam properties (dimensions, uniformity),
- Radiation qualities (X-ray),
- For X rays at SSDLs HV cables (silicon paste isolation),
- Positioning systems (lasers),
- optical telescope,
- rod micrometre set and a digital calliper (positioning devices).





Measuring equipment

- Periodically calibrate equipment that has an impact on your measurements;
  - Ionization chambers,
  - Electrometers,
  - Temperature measuring system,
  - Hygrometers,
  - Barometers,…
- Period of calibration is determined by looking at the history of the equipment stability which you can build with time if there is no recommendation/regulation

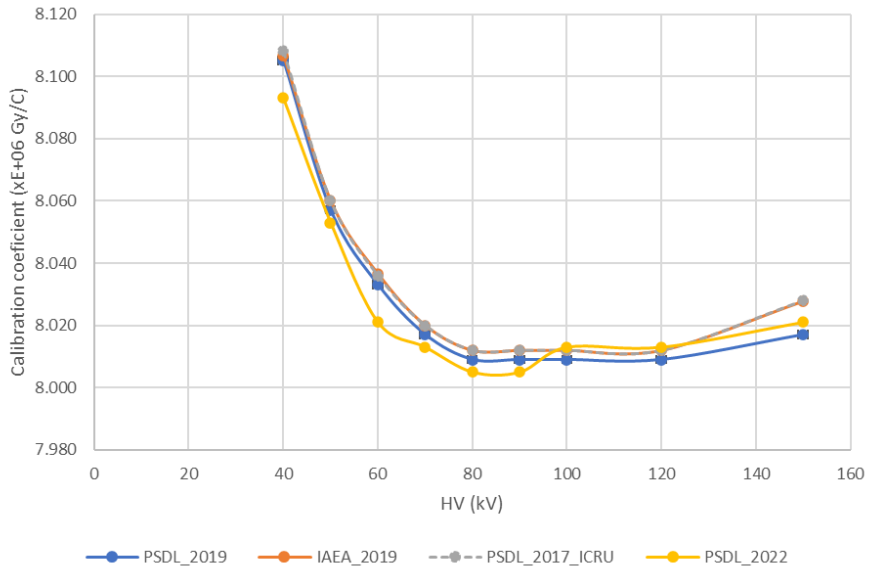
Measuring equipment

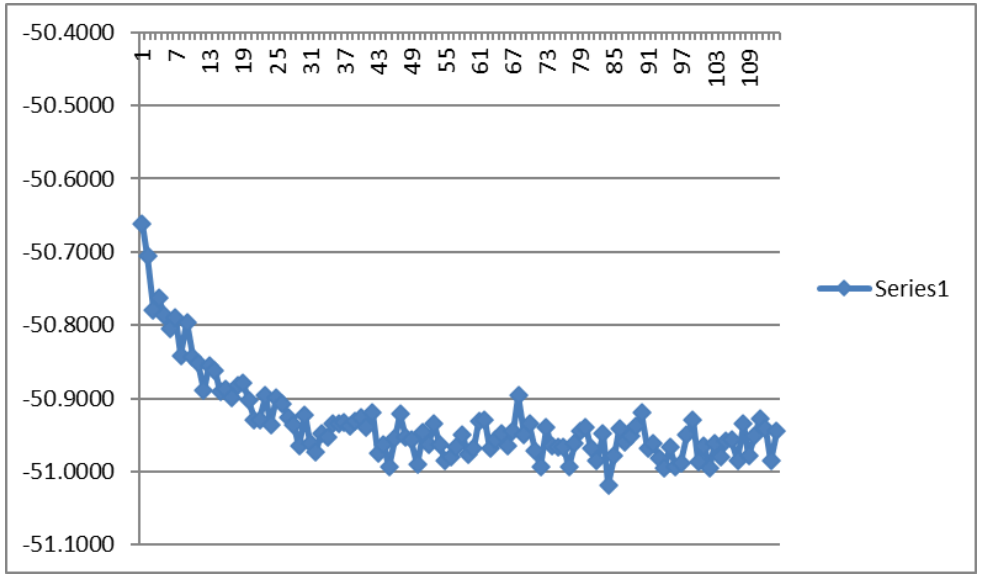
- Visual checks on the others to ensure they are still good for use
  - Cables
    - No kinks
  - Connectors
    - No dust on connectors and adapters, keep caps on
  - Adapters
    - When using adapters please be careful as you are dealing with high voltage
  - Phantoms
    - Avoid growing algae and/or having particles in the water tank

Chamber commissioning

Several factors can influence the chamber response:

- Detector production itself,
- Electrical connectors,
- Humidity,
- Leakage,
- Recombination,
- Polarization,
- Energy response,
- Stabilization time,
- Reproducibility of measurements,…





Standard and manufacturer specifications

- For Reference IC performance you can get some commissioning tips and tolerance ranges for different performance requirements from IEC 60731 or the manufacturer specifications
- Manufacturer specifications can also be used
- Technical specifications of what was promised by the seller during the bidding period
- TRS 492 gives details of the tests to be done for well type chambers and these apply to any reference chamber

TRS 492

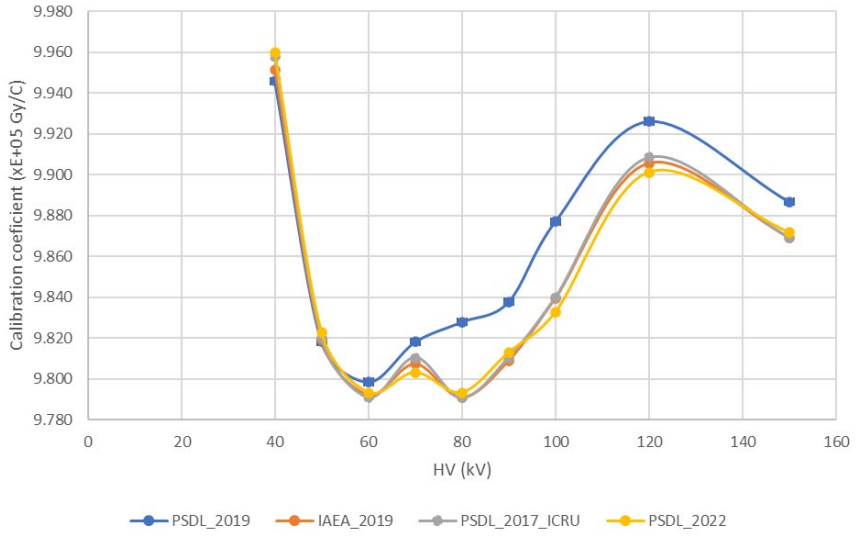
TABLE 6. COMMISSIONING TESTS OF THE WELL-TYPE CHAMBER AND ASSOCIATED TOLERANCE LEVELS FOR REFERENCE-CLASS (RESULTS FOR THE EVALUATED TESTS ARE SUPPOSED TO BE CONSISTENT ALSO WITH MANUFACTURER SPECIFICATION)

Test	Tolerance
Mechanical integrity Can be verified by a physical check; radiographic images of the system might also help to possibly detect internal damage or loose cable connections.	No damage or loose cable connections; free vent hole.
Leakage current Should be measured with the method described in Section 8.2.3.4. The extension cable will also be verified if it is used in the standard measurement conditions. Due to the low ionization current from LDR sources, it is recommended that no extension cable be used for such sources.	<0.1% of the signal for an HDR/PDR source; <1% for an LDR source.
Sweet spot length For its quantification, the procedure for the sweet spot determination will be followed (see Section 8.2.1).	>3 cm (or larger than the length of the source being measured) for HDR/PDR/LDR brachytherapy sources.
Ion recombination Should be measured with the source dwelling in the sweet spot using the method described in Section 8.2.3.7.	≤0.2% for HDR/PDR/LDR brachytherapy sources.
Polarity effect Should be measured with the source dwelling in the sweet spot using the method described in Section 8.2.3.6.	If the chamber is operated at the same polarizing voltage and voltage gradient as used during calibration at the calibration laboratory, no polarity correction needs to be applied by the user. This is only required if the polarizing voltage and voltage gradient have the opposite sign compared to the settings used at the calibration laboratory.
Short term repeatability Can be quantified as the standard deviation of a minimum of ten charge measurements, with the source dwelling in the same source position for the same dwell time (see Section 8.4). Two different tests need to be performed. (a) Measurements are repeated, and the source is not removed between one measurement and the other. (b) Measurements are repeated, and the source is removed and put/transferred back between one measurement and the other.	<0.1% for an HDR/PDR source[a]; <1% for an LDR source[a].

[a] The tolerance values both apply for tests (a) and (b).

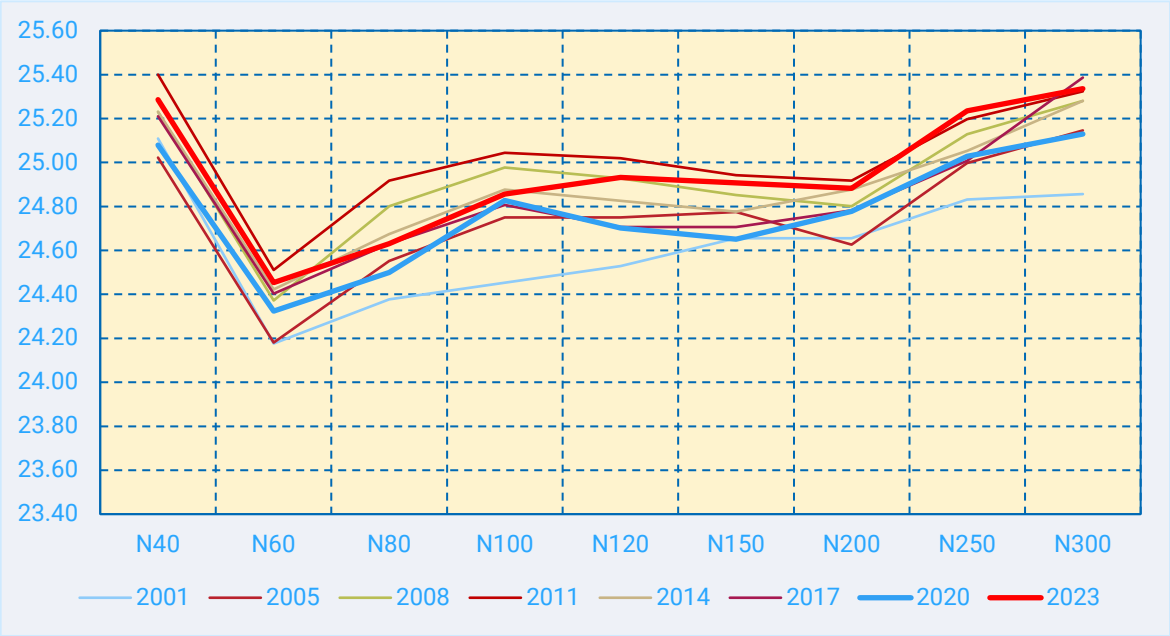
Know your chamber

- Take a radiograph of your chamber
- Where is the chamber going to be used now, and possible be used in the future?
- Determine the correction factors for your new system e.g. k_{pol} , k_{leak} , k_s *etc.*
- When using different electrometers from different manufacturers understand how each applies the voltage and document it in your procedures
- Get the chamber calibrated for the full range where it is possible going to be used

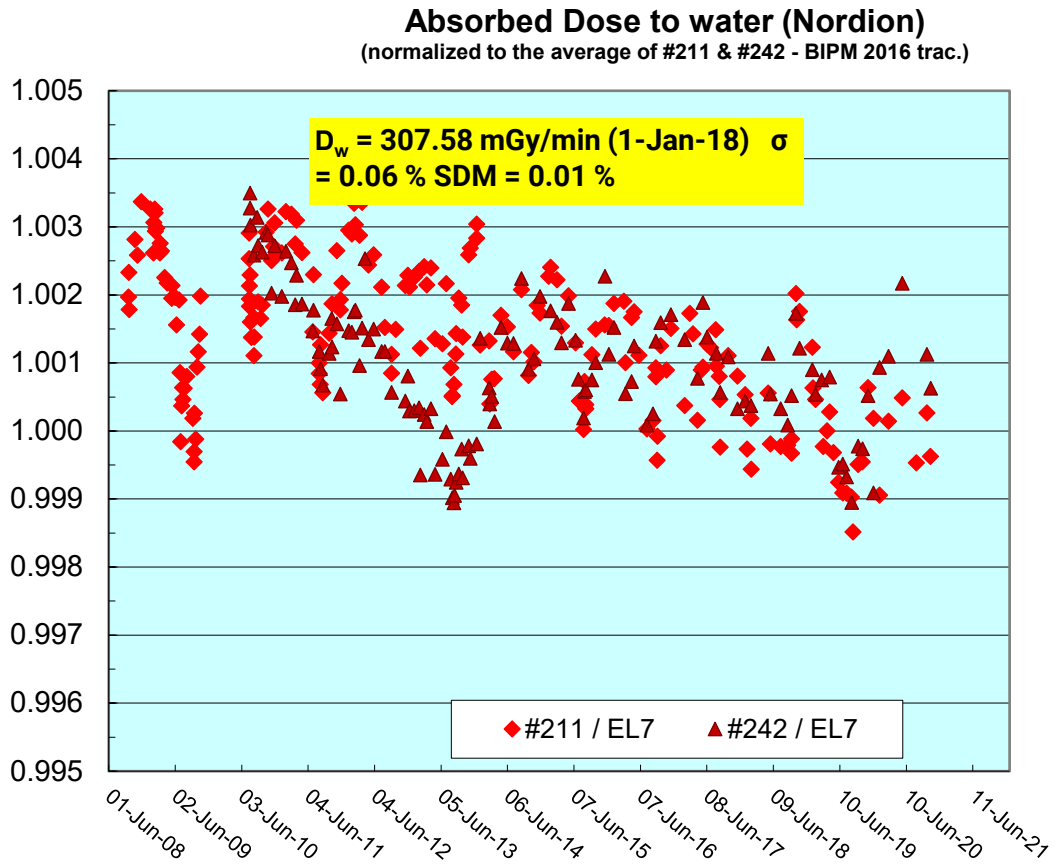


Identifying any possible deviation from specification during commissioning adds advantage tat chamber may be returned to manufacturer at their costs

Chamber stability



Chamber response over time



Beam output

Used of spreadsheets

- Validate the spreadsheet before use and periodically check this
- Lock the cells that have formulae

Training of staff

“Training a qualified radiation metrologist/ medical physicist takes time”

“Consideration also needs to be given to the sustainability of human resource capacity”

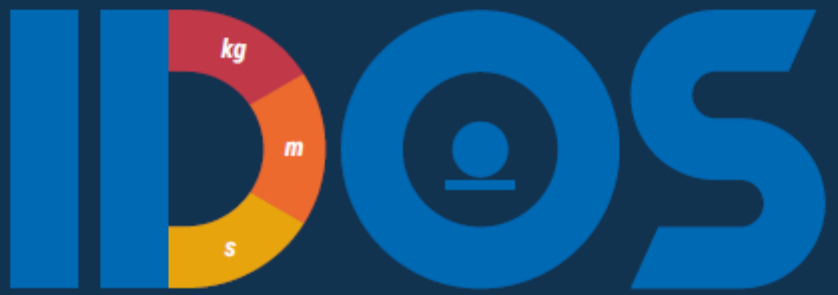
“A **shortage** of adequately **trained** staff is a serious obstacle to the appropriate operation of an SSDL and its official recognition.”

Continuing education of staff is crucial

INTERNATIONAL SYMPOSIUM

50 YEARS
of the IAEA/WHO SSDL Network

Standards, Applications and Quality Assurance in Medical Radiation Dosimetry



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