The NPL Practical Course in Reference Dosimetry

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Introduction

The Practical Course in Reference Dosimetry run by the National Physical Laboratory is primarily aimed at radiotherapy physicists and would benefit anyone wishing to improve their practical dosimetry techniques.

Introductory lectures to the course cover basic quantities and units, an overview of dosimetry and evaluation of uncertainties. As introduction to the four practical sessions run later in the course a series of further lectures cover dosimetry at NPL and in the clinic. Complementary lectures are given by NPL staff and experienced hospital physicists and cover the dosimetry of kV x-rays, high-energy photons, electrons and HDR brachytherapy.

The final, very popular lecture, gives practical advice on the handling and maintenance of secondary standard and field instruments with emphasis placed on recognising and dealing with measurement problems.

"Excellent - humorous, clear, informative with practical examples - the perfect combination for a talk you will remember!"

Chamber & case: one careful owner

Practical sessions cover all areas of measurement including basic metrology, estimating uncertainties and applying corrections. Advice is given on obtaining a secondary standard calibration factor and how to use the current Codes of Practice. There is also ample opportunity to discuss measurement issues with both experienced NPL staff and hospital physicists.

"The practical sessions were fantastic - extremely well presented & useful. All the facilitators were easy to approach & explained the procedures very clearly."

Supplementary to the four main practical sessions described in more detail below there is an additional practical session covering check source measurements. The course also provides an opportunity to view and learn about the UK primary standards for kV x-ray, high-energy photon, electron and HDR brachytherapy dosimetry.

kV X-ray dosimetry practical session

This session covers the low- and medium-energy sections of the IPEMB code of practice (and associated addendum) for the determination of absorbed dose for x-rays below 300kV generating potential[1, 2].

The initial aim of the session is to measure the first half-value layer (HVL) for both low- and medium-energy x-ray beams, and by interpolation from the NPL chamber calibration certificate determine the secondary standard calibration factor in both beams. Subsequently the secondary standard chamber is used to calibrate the field instrument for each beam as recommended by the code of practice, by simultaneous irradiation either in air or in a water phantom. This calibrated field instrument is then used to determine absorbed dose in the beam (output of the x-ray tube) at the surface of the phantom and at the reference depth.

"Given really good tips on recording measurements and techniques. Had good fun too!"

"Excellent. All the experiments were applicable to the clinical situation and were set out and described well. Staff were very friendly and helpful."

kV x-ray practical session

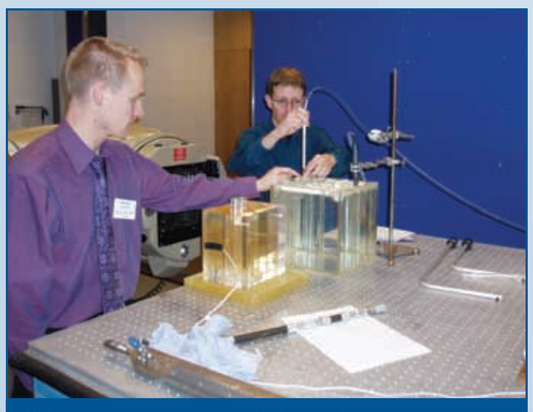
High-energy photon dosimetry practical session

This session covers the IPSM code of practice for high-energy photon therapy dosimetry based on the NPL absorbed dose calibration service[3].

The initial aim of this session is to measure machine output and beam quality index, Tissue Phantom Ratio 20/10 ($TPR_{20/10}$), in a high-energy photon beam, which for this session is a Cobalt 60 beam. The secondary standard calibration factor is then determined using the NPL chamber calibration certificate and compared to the tabulated value given in the certificate. Subsequently the secondary standard chamber is used to calibrate the field instrument first by substitution in water and then side-by-side in a Perspex phantom.

"A great way to learn - excellent supervisors - a bit scary to handle someone else's equipment but made fun."

"Very enjoyable and extremely interesting. It will be very helpful in practice. I really appreciate all the help, especially with calculations including uncertainties."



High-energy photon practical session

High-energy electron dosimetry practical session

The aim of the session is to cover the IPEM 2003 code of practice for electron dosimetry based on an absorbed dose to water calibration[4], an overview of the formalism, practical procedures and recommendations. The majority of the session is also relevant to the IAEA code of practice TRS-398 and AAPM protocol TG-51. The focus of the session is on theoretical and measurement issues in the IPEM code of practice: determination of beam quality, reference depth, absorbed dose to water calibration factor, experimental set-up (SSD, field size, position of chamber, phantom size), corrections for influence quantities (pressure and temperature, polarity, recombination) and beam output measurement.

High-energy electron practical session

By the end of the practical session all participants should be familiar with the factors required to determine absorbed dose and will have derived a value for the output factor of the NPL linear accelerator.

"Very good and helpful to really clarify the 2003 Code of Practice. Incredibly useful having a member of the working party present."

"A lot to get through but worth the effort. Excellent supervisors - helpful, clear, made it an enjoyable experience."

HDR brachytherapy dosimetry practical session

The aim of this session is to determine the reference air kerma rate (RAKR) of a conventional HDR ^{192}Ir brachytherapy source using a re-entrant well-type ionisation chamber that has been calibrated against the NPL primary standard.

Firstly the response curve of the ionisation chamber is measured by stepping the ^{192}Ir source through the chamber. The measurement of RAKR is then performed at the dwell position corresponding to the position of maximum chamber response. An ion recombination correction factor is then determined using the two-voltage technique and applied.

Finally, the RAKR of the ^{192}Ir source is converted to absorbed to water at a reference point by applying the formalism described in the AAPM protocol TG-43 and its update[5, 6].

HDR brachytherapy practical session

"Appreciated the efforts by the staff demonstrating the routine chamber calibration procedure in a clinical environment."

What people think?

Particularly appreciated has been the way in which the practical sessions allow the students to make measurements themselves in a variety of measuring modalities rather than merely looking over a shoulder. The course is arranged to have a favourable teacher to student ratio, with between two and four NPL staff available for each group of six students throughout the practical sessions allowing ample opportunities for discussion.

"The course was excellently organised. Credit to all the staff involved for their enthusiasm, approachability and general hospitality. I thoroughly enjoyed this course and would recommend that all junior grade radiotherapy physicists attend."

"All in all, an excellent course which I'll have no hesitation in recommending to colleagues."

"The course was extremely relevant and I thoroughly enjoyed it. I think it has emphasised the care needed when making field measurements."

"Having done some clinical dosimetry I wasn't sure how much extra I would learn, I thought it would just clarify - little did I know that I would learn a lot both practically and theoretically - well worth it!"

"The notes are thorough and well written, the practicals - very useful and with such a high student to supervisor ratio it was fantastic. Thanks for a great course."

First course run in 2002

References

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Taking a well-earned break!

Acknowledgements

Many thanks for their invaluable contribution go to:

Dr Edwin Aird, Dr Mania Aspradakis, Roger Aukett, Margaret Bidmead, Tony Greener, Nick Jenkins, Tom Jordan, Elizabeth Macaulay, Dr Malcolm McEwen, Professor Andrew Nisbet, Dr Karen Rosser, Dr Andrew Williams.

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