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Participants of AFRIMETS General Assembly, South Africa, 16-17 July 2009 (courtesy of Ms. Sara Prins)

From the editor

It is with great sadness and regret that I inform the readers about the death of Mr. Johann Georg Haider, retired IAEA staff member. Mr. Haider passed away on Tuesday 28 April 2009 in his home town of Vienna (see page 4).

Mr. Ken Shortt, former Head of the Dosimetry and Medical Radiation Physics Section from August 2001 to December 2007, retired and returned to Canada. Mr. Ahmed Meghzifene, former SSDL-Officer, was appointed Section Head in June 2009.

This issue contains information about four new IAEA activities in the field of dosimetry and medical radiation physics. They cover a broad spectrum of topics, from education and promotion of medical physics through new activities in radiotherapy dosimetry audits and quantitative nuclear medicine imaging to calibrations of radiation protection instruments. Initial meetings for these projects were organized in 2009.

The new TRS 469 is a continuation of the IAEA effort to provide guidance on calibration of dosimeters. It fulfils the need for a systematic and standardized approach to the calibration of reference dosimeters used in external beam radiotherapy by the SSDLs.

Furthermore, information is also given on the forthcoming IAEA international dosimetry symposium, Intra-Africa Metrology System (AFRIMETS), IAEA publications and upcoming meetings in dosimetry and medical radiation physics.

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SERVICES PROVIDED BY THE IAEA IN DOSIMETRY AND MEDICAL RADIATION PHYSICS

The IAEA's Dosimetry and Medical Radiation Physics Section focuses on services provided to Member States through the IAEA/WHO SSDL Network and on a system of dose quality audits. The measurement standards of Member States are calibrated, free of charge, at the IAEA's Dosimetry Laboratory. The audits are performed through the IAEA/WHO TLD postal dose assurance service for SSDLs and radiotherapy centres.

The IAEA Calibration and Measurement Capabilities (CMCs) have been reviewed and published in the CIPM's (Comité International des Poids et Mesures) Appendix C. The Dosimetry Laboratory's Quality Management System has been reviewed and accepted by the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB).

Additional information can be found at the following web site: http://kcdb.bipm.org/AppendixC/search.asp?met=RI

The range of services is listed below.

Services	*Radiation quality*
Calibration of ionization chambers (radiotherapy, diagnostic radiology including mammography, and radiation protection including environmental dose level)	X rays (10–300kV)* and gamma rays from ^{137}Cs and ^{60}Co
Calibration of well type ionization chambers for low dose rate (LDR) brachytherapy	γ rays from ^{137}Cs (*source of traceability has been changed from NIST to PTB (effective January 2009).*
Comparison of therapy level ionization chamber calibrations (for SSDLs)	γ rays from ^{60}Co
TLD dose quality audits for external radiotherapy beams for SSDLs and hospitals	γ rays from ^{60}Co and high energy X ray beams
TLD dose quality audits for radiation protection for SSDLs	γ rays from ^{137}Cs
Reference irradiations to dosimeters for radiation protection	X rays (40–300 kV)* and γ rays from ^{137}Cs and ^{60}Co beams

*** Calibrations in X ray beams will not be available till December 2009, because of X ray equipment replacement**

Member States who are interested in these services should contact the IAEA/WHO SSDL Network Secretariat for further details, at the address provided below. Additional information is also available through the Internet at the web site: *http://www-naweb.iaea.org/nahu/dmrp/ssdl.asp.*

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Note to SSDLs using IAEA calibration and audit services:

1. To ensure continuous improvement in IAEA calibration and audit services, SSDLs are encouraged to submit suggestions for improvements to the Dosimetry Contact Point.

2. Complaints on IAEA services can be addressed to the Dosimetry Contact Point.

Mr. Johann Georg Haider

It is with great sadness and regret that I inform the readers about the death of Mr. Johann Georg Haider, retired IAEA staff member. Mr. Haider passed away on Tuesday 28 April 2009 in his home town of Vienna.

Mr. Haider was one of the leading IAEA staff who contributed to the design and setting-up of the IAEA dosimetry laboratory in Seibersdorf in 1979 as well as many member laboratories of the IAEA/WHO SSDL network. Together with Mr. Reinhard Girzikowsky (IAEA staff in Seibersdorf), he also designed much of the equipment and devices used at SSDLs around the world (see pictures), including protection level irradiators, precision measurement carts, a fast-shutter for X-ray machines, filter-changing devices, etc.

Mr. Haider was much known to many SSDL staff around the world. Through Technical Cooperation Projects, he has helped many countries in the establishment of an SSDL. He was an excellent engineer and highly qualified in dosimetry. His broad technical expertise in mechanics coupled with his deep knowledge of dosimetry requirements for ionizing radiation has allowed him to provide support and expertise in all technical fields related to SSDLs. He certainly had the capabilities to do all jobs: shielding calculations, welding iron and alloys for shielding-doors and precision measuring benches, installing various electronic devices and interlocks, fixing electrometers and ion chambers, etc. If he had one drawback, it would be his eagerness to do everything by himself in day and night shifts.

Most of you who knew him will probably remember him as a very dedicated and committed professional.

May his soul rest in peace.

Ahmed Meghzifene
Section Head, DMRP

Robust and reliable precision measuring cart.

A half-value layer measurement system for X ray beams and its automatic filter wheel.

Announcement

International Symposium on Standards, Applications and Quality Assurance in Medical Radiation Dosimetry

9-12 November 2010
Vienna, Austria

Organized by the
International Atomic Energy Agency

http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=38093

The major goal of the symposium is to provide a forum where advances in radiation dosimetry, radiation medicine and radiation protection during the last decade can be disseminated and scientific knowledge exchanged. It will include all specialties in radiation medicine and radiation protection dosimetry with a specific focus on those areas where the standardization of dosimetry has improved in recent years (brachytherapy, diagnostic radiology and nuclear medicine). It will also summarize the present status of technology, outline future trends in medical radiation dosimetry and identify possible areas for improvement. Its conclusions and summaries should lead to the formulation of recommendations for the scientific community.

This symposium will be of interest to a broad spectrum of medical physicists and other scientists working in radiation dosimetry with responsibilities in the following fields: radiation metrology, external beam radiotherapy with photons, electrons and hadrons, brachytherapy, diagnostic radiology including CT, mammography and interventional procedures, nuclear medicine and radiation protection dosimetry.

The symposium will provide an opportunity for scientists working in medical institutions, research centres, universities and standards laboratories to meet for discussions covering the entire dosimetry chain.

The symposium will consist of 16 basic sessions: four sessions per day of about 90 min each, including the opening session, a series of topical sessions with oral and poster presentations, a round-table session and a concluding session.

The opening session will include welcoming addresses by representatives of the IAEA and co-sponsoring organizations followed by at least one keynote presentation that will discuss the accuracy requirements in medical radiation dosimetry, as an overview which includes radiotherapy, diagnostic radiology and nuclear medicine.

A series of topical sessions will then cover selected areas of medical radiation dosimetry, from standards laboratories to the medical applications in radiotherapy, diagnostic radiology and nuclear medicine. Each topical session will include one or two keynote invited presentations of 30 min followed by four to six oral presentations and related discussions. Poster presentations for each topic will be an important component of the symposium, and their display will be maintained during the symposium. The chairpersons will summarize the sessions including highlights of selected posters. They will also prepare recommendations for the concluding session.

At the concluding session, the topical session chairpersons will present their summaries, which should lead to the formulation of recommendations for the scientific community.

The symposium will cover recent developments in the field of radiation dosimetry standards, applications and quality assurance. The IAEA welcomes both academic and practice based contributions on the following topics:

- Radiation measurement standards for imaging and therapy
  - CIPM (International Committee for Weights and Measures) MRA (Mutual Recognition Arrangement) and ionizing radiation comparisons and calibrations
  - Standards for absorbed dose to water, air kerma, activity measurements, ambient and personal dose equivalent

- Basic data for dosimetry
- New water and graphite calorimeter developments (small fields, protons, and heavier charged particles)
- Standards for radionuclide activity measurements for quantitative imaging
- Standards for brachytherapy: reference air kerma and absorbed dose to water
- New developments of standards (alanine, diamonds) etc
- Quality management of secondary standard dosimetry laboratories
- Dosimetry audits for Secondary Standards Dosimetry Laboratories
- Calibration of diagnostic radiology detectors (mammography, CT-chambers, KAP, beam quality measuring devices)

- Reference dosimetry and comparisons in external beam radiotherapy
  - Status of the international dosimetry protocol in radiotherapy dosimetry, Technical Reports Series No. 398
  - New developments in national calibration protocols
  - Beam quality (non-standard beams, flattening filter-free beams)
  - Perturbation and correction factors
  - Calibration of small and non-standard radiotherapy fields (Intensity-Modulated Radiation Therapy incl. phantoms, stereotactic radiotherapy and radiosurgery, etc.)

- Reference dosimetry and comparisons in brachytherapy
  - Dissemination and clinical use of standards
  - Status of brachytherapy dosimetry protocols
  - New radiation sources for brachytherapy (implantable X ray tubes, mixed radionuclide sources, etc.)
  - Dosimeters for brachytherapy

- Clinical dosimetry in X ray imaging
  - Implementation of the international dosimetry protocol in X ray diagnostic radiology (Technical Reports Series No. 457) and recommendations of ICRU 74
  - Beam quality measurements
  - Hospital calibration of dosimeters (KAP meters and other devices)
  - Developments in clinical dosimetry (incl. digital radiology, mammography, CT (incl. cone beam), fluoroscopy, interventional radiology, and dental radiology)
  - Image quality and dose optimization incl. diagnostic reference levels
  - Patient specific dosimetry
  - Reducing uncertainty in using patient dosimetry protocols
  - Mathematical phantoms for dose calculations including patient size corrections
  - Foetal and paediatric dosimetry

- Clinical dosimetry in radiotherapy
  - Issues in beam commissioning and modelling for dose calculation
  - Verification of treatment planning process (algorithms, data input, dose verification, etc.) in external beam and brachytherapy
  - Dosimetry for imaging devices used in image-guided radiation therapy
  - Dosimetry of special procedures (Intraoperative radiation therapy, total body irradiation)
  - In-vivo dosimetry
  - Patient specific dosimetry (Intensity-Modulated Radiation Therapy, stereotactic radiosurgery, etc.)
  - Out of field dosimetry
  - Detectors:1-D, 2-D and 3-D

- Internal dosimetry for diagnostic and therapeutic nuclear medicine
  - Calibrations and procedures for measurements of activity (Technical Reports Series No. 454)
  - Imaging device simulations
  - Quantitative imaging (phantoms and procedures)
  - Pharmacokinetic models for dosimetry
  - Pre-clinical (translational) dosimetry
  - Dosimetry for paediatric studies (mathematical phantoms)
  - Patient-specific dosimetry
  - Imaging-based dosimetry (PET, SPECT)
  - Dosimetry for targeted radionuclide therapy (peptides, antibodies, small molecules)
  - Dosimetry for new radiopharmaceuticals for use in therapy (including alpha emitters)

- External quality audits
  - Dosimetry audits in radiotherapy (national and international dosimetry audit networks, postal and on-site audits in reference and non-reference conditions using simple and semi-anatomical phantoms)
  - Credentialing for clinical trials through the use of phantoms
  - Comprehensive audits (diagnostic radiology, nuclear medicine, radiotherapy)

- Radiation protection dosimetry
  - Use of radiation protection quantities (effective and equivalent dose, intake)

  - Occupational dosimetry for medical workers (incl. pregnant staff)
  - Dosimetric characterization of medical workplaces (PET, PET/CT, protons, etc.)
  - Measurement techniques around pulsed sources
  - Personal dosimetry comparisons

- Dosimetry for proton and heavier charged particle beams in radiotherapy
  - Implementation of ICRU 78
  - Update of the international dosimetry protocol TRS 398
  - Basic data for dosimetry
  - Perturbation and other correction factors
  - Proton radiography
  - Patient specific dosimetry and PET
  - Neutrons and out of field dosimetry

Contact at the IAEA:

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Key deadlines and other information will be available on the IAEA website.

Scientific committee of the International Dosimetry Symposium Meeting at the IAEA Headquarters (courtesy of E. Izewski).

The idea of a greater African metrology system was conceptualized in 2004-2005 and Inter-Africa Metrology System (AFRIMETS) was established during 2006-2007. The Inaugural General Assembly meeting was held at the premises of the New Partnership for Africa's Development (NEPAD) in Midrand, 1-2 July 2007 where the Memorandum of Understanding was finalized and subsequently signed by representatives from bodies representing official metrology institutes from 38 African countries. The second General assembly was held in Tunis in July 2008. The third AFRIMETS General Assembly meeting was held in South Africa on 16 and 17 July 2009. The GA was preceded by the working group meetings and the working group for ionizing radiation. The state of SSDLs in Africa (traceability, quality and training) and the comparison needs for members was discussed.

The main goal of AFRIMETS is to harmonize accurate measurement in Africa, establish new measurement facilities and gain international acceptance for all measurements, especially those critical to export, environmental monitoring and sanitary and phyto-sanitary issues. It is also envisaged that AFRIMETS will promote Africa's metrology interests and its effective participation in international standard-setting bodies. AFRIMETS is the Regional Metrology Organisation (RMO) representing Africa at the Joint Committee of the Regional Metrology Organisations and the BIPM (JCRB). One of the tasks of the JCRB is to coordinate the activities among the RMOs in establishing confidence for the recognition of calibration and measurement capabilities, according to the terms of the International Committee for Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA).

The six sub-regional metrology organisations are the principal members and represent 44 nations in Africa. They are CEMACMET (Economic and Monetary Community of Central Africa Metrology Programme), EAMET (East African Metrology Programme), MAGMET (Maghreb metrology), NEWMET (North-East and West Africa Metrology programme), SADCMET/MEL (Southern Africa Development Community Cooperation in Measurement Traceability and SADC legal metrology), and SOAMET (West African Secretariat for metrology. The countries under each sub RMO are:

CEMACMET (Cameroon, Central African Republic, Chad, Equatorial Guinea, Gabon, and Republic of Congo);

EAMET (Burundi, Kenya, Uganda and Rwanda);

MAGMET (Algeria, Morocco, Mauritania and Tunisia);

NEWMET (Egypt, Ethiopia, Ghana, Nigeria, Libya and Sudan);

SADCMET/MEL (Angola, Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe);

SOAMET (Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo).

National Metrology Institutes outside Africa, designated institutes in Africa, and other institutes in Africa responsible for accurate measurement can become associate members. Other organisations can have observer member status.

AFRIMETS Structures are in place and can be viewed at its website, www.afrimets.org

In the Structure, there are technical committees (TC's), which have Scientific and Industrial and Legal Metrology sub sections. Under TC1 there are working groups (WGs) for each technical area, for example a WG for ionising radiation. All member national metrology institutes (NMIs) are welcome to join the WGs.

Most ionising radiation laboratories in the region are not within national metrology institutes.

An invitation was and is extended to all ionising radiation laboratories, including those that are members of the IAEA/WHO SSDL network, to join AFRIMETS as associate members (at no cost). This will benefit laboratories in that they can participate in all activities of AFRIMETS, except that they will not have a vote (the vote for the country resides with its official representative).

Interested SSDLs should send a letter, on their company letter head, to the AFRIMETS secretariat at the National Metrology Institute of South Africa (NMISA) stating their intention to join. The membership is per parent institute. The contact details are:

Dr. Wynand Louw, Fax: +27 841 3382 or e-mail: wlouw@nmisa.org

Please CC to: zmsimang@nmisa.org

Technical Cooperation Project on Strengthening Medical Physics in Radiation Medicine

The medical physicist fulfils an essential role in the safe and effective use of radiation in medicine, most commonly in cancer treatment and diagnostic imaging. Cancer rates are rising worldwide, markedly so in developing counties who thus require additional medical physics support. In recent years, the increasing complexity of both treatment and diagnostic radiation equipment coupled with the raising of the expectations of good health care, as well as the implementation of more stringent radiation safety standards and accreditation requirements, has exacerbated the already critical shortage of fully competent medical physicists in the developing world. The IAEA seeks to address these problems in a number of ways, not only by providing support to Member States in education and training in medical physics but also by supporting the development of educational material, jointly with professional societies and international organisations.

Beginning in 2009, a new interregional Technical Cooperation project, on *Strengthening Medical Physics in Radiation Medicine* (INT/6/054) was initiated after the approval by the IAEA Board of Governors in November 2008. The project will have duration of 5 years and aims at promoting the recognition of medical physics in radiation medicine and harmonizing educational material.

On 18-20 May 2009 the first planning and coordination meeting of the INT/6/054 project was held at IAEA Headquarters in Vienna, bringing together medical physicists from around the world, and representatives from the medical physics professional societies including the International Organisations for Medical Physics (IOMP), the European Federation of Organisations for Medical Physics (EFOMP), the American Association of Physicists in Medicine (AAPM), the Latin American Association of Medical Physics (ALFIM), the Asia-Oceania Federation of Organisation for Medical Physics (AFOMP), the European Society for Therapeutic Radiology and Oncology (ESTRO), the World Health Organisation (WHO), the European Commission (EC), and the International Radiation Protection Association (IRPA). The meeting participants presented the work of their respective organisations and discussions were held on how to meet the project objectives.

Proper academic education and clinical training is a vital requisite for the medical physicist to properly fulfil their roles and responsibilities. Many issues highly relevant to the medical physics profession were reviewed and discussions focused on how to improve education and training, status and recognition of medical physics worldwide. The adequate full training of a medical physicist should include academic training at the post-graduate level, as well as structured clinical training. Participation in a professional continuing education programme is also necessary to ensure the knowledge of the medical physicist is informed and current.

Working groups to address the specific issues were formed and will continue to collaborate on strengthening medical physics in radiation medicine.

The expected outputs of this project are:

- A document on 'Role and Responsibilities of Medical Physicists in Radiation Medicine' to increase awareness of decision makers in clinical and policy matters/settings.
- A guidance document on the educational and clinical training requirements including registration/certification of clinical medical physicists.
- A guidance document on recommended staffing levels in radiation medicine according to internationally accepted standards.
- Identification of gaps in currently available educational material and recommendations for course curricula and guidance for trainers.

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INT6054 group photo, May 2009 (courtesy of E. Izewski).

New IAEA Co-ordinated Research Project on Quantitative Nuclear Medicine Imaging

In addition to providing images for direct evaluation, nuclear medicine instruments have the potential to provide quantitative information about radiopharmaceutical uptake, as well as its distribution over time. Obtaining images that are suitable for quantitative tasks can require additional processing compared to those used for visual interpretation. However, this additional processing often results in improved resolution, contrast, and reduced artifacts. These improvements in the image can often, but not always, translate directly to improved performance on detection tasks. Measurements from quantitatively accurate images are more consistent across patients, centres, and imaging equipment. Such images also facilitate clinical applications based on quantitatively accurate data, such as targeted radiotherapy treatment planning and advanced kinetic analysis. These advantages have led to an increasing interest in quantitative nuclear medicine imaging.

As the technology for quantitative imaging has become more mature the techniques have migrated from research institutions into clinical practice. Sites where resources are more limited are now able to be involved in projects requiring these imaging techniques. In order to ensure the best health care for people served by these sites it is timely to investigate the implementation of quantitative imaging at such sites, to ensure the adoption of safe and sustainable health care at the highest level achievable within the limitations of the available resources. This is why the IAEA has initiated a new co-ordinated research project (CRP E2.10.07) on this topic.

There is a lack of harmonized protocols and guidelines for acquiring quantitative information from nuclear medicine instruments. Nor are there international documents that address the possibilities and limitations of these instruments for quantitative information. Acknowledging this, the project is expected to produce guidance documents that i) describe the methods required for quantification, including the definition of a standard set of physical and computer tools for ensuring consistent quantification in nuclear medicine; and ii) define what levels of reliability should be achievable with different levels of technology and for various tasks. The overall objective of this project is to assist Member States in accurately determining radionuclide distributions for diagnostic and therapeutic nuclear medicine.

The participants of the CRP were selected in June 2009. Eight applicants were awarded research contracts and three were selected as agreement holders. In addition to the research proposed by each applicant, there will be joint exercises for evaluating the accuracy with which one can determine the amount of activity. The primary standards laboratory of the USA, NIST, will be given the task of providing standard phantoms with homogeneous solutions of radioactivity and the participants will derive estimates of uncertainties for various nuclear medicine procedures. This will increase our understanding of what accuracy can be currently achieved, and help finding ways to improve it. Ultimately, better patient-specific dosimetry for diagnostic and therapeutic nuclear medicine can be expected. The first research coordination meeting, RCM, will take place in Vienna 14 December 2009.

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Development of Quality Audits for Radiotherapy Dosimetry for Complex Treatment Techniques: A New IAEA Co-ordinated Research Project

Background

There have been two previous CRPs (E2.40.07 and E2.40.12) which have established and tested a framework for operating national audit networks for radiotherapy dosimetry and developed methodology and procedures for TLD-based beam dosimetry checks in those networks. Guidelines have been made available [1] on how to structure External Audit Groups (EAGs), to have a strong involvement and collaboration of clinical medical radiotherapy physics representatives, SSDLs and the TLD measuring centre. EAGs from thirteen countries have been involved in those CRPs. One main objective of this work was for the expertise acquired in the CRP activities and studies to not only be applicable to the national audit networks involved, but also to be relevant for any other countries interested in setting up a dosimetry audit system.

Previous CRPs have established an approach to radiotherapy dosimetry audit that is based on a process of increasingly complex steps and parameters. An audited centre must successfully complete the lower level audits before moving on to the higher level audits. This approach was developed so that there can be a clear rationale, relevant to radiotherapy accuracy, quality and safety, for exerting efforts and continuing to a next step of auditing addressing more complex situations, including more complex parameters that would be involved in clinical patient treatments. Such complex audits are increasingly important, as demand is rising, technology for radiotherapy becomes more complex, equipment features and designs evolve. The implementation of more complex treatment techniques compels improvements in knowledge and practice quality. For example:

- New linear accelerators currently being acquired by radiotherapy centres have multi-leaf collimators (MLC) for beam shaping and for normal tissue sparing, making conformal radiotherapy much more easily and widely available. Conformal radiotherapy enables less normal tissue to be included in the treatment area and offers the potential for lower rates of radiation induced side-effects in those normal tissues. This can then enable higher doses to be delivered to the tumour and therefore increase the probability of cure rates;
- A significant number of radiotherapy centres have the capability for small field stereotactic radiotherapy treatment. This can be provided by a range of devices, including the use of smaller-leaf MLCs (at this stage other approaches are outside the scope of this CRP);
- More treatment machines are being installed with the capability for new treatment techniques such as intensity modulated radiotherapy (IMRT) and this capability is now available in many radiotherapy centres. IMRT requires very complex dosimetry, QA and verification;
- Increasingly complex treatments require more sophisticated modelling by the treatment planning system (TPS) for the differences in radiation dose deposition due to heterogeneities in body composition, particularly lung but also bone, in order to optimally make use of the capabilities of more complex treatments and equipment.

The current CRP E2.40.16 is intended to build upon the work from the previous two CRPs and extend the scope of those participating national audit networks to cover these clinically relevant complex situations. The audits proposed in this CRP are more relevant to clinical practice than previous audits and involve significant testing of the treatment planning systems and methods, as well as dose delivery, and as such require detailed involvement of the clinical radiation oncology physicist members of the EAGs in the national networks.

The main phase of the project will be conducted over three years, 2009-2011. It has been preceded by an expert meeting in 2008 which has developed the CRP outline.

Objectives, research scope and outcomes

The objective of the CRP is to develop and make available a methodology and procedures for national EAGs for dose measurement of complex radiotherapy parameters used in cancer treatment. This will include TLD based dosimetry for irregular MLC fields for conformal radiotherapy, for heterogeneous situations, and for small MLC shaped fields relevant to stereotactic radiotherapy and applicable to dosimetry for IMRT. In addition it will include a new 2D dosimetry auditing procedure with radiochromic film for testing dose distributions, specifically beam penumbra, in small field geometry.

The action plan for each audit step above will involve a feasibility study, a multi-centre pilot study and trial audit runs at a few local hospitals. The purpose of the feasibility study is to review the technical aspects of the audit procedures and to validate the newly developed forms and instructions. The multi-centre pilot study will focus

on conducting and evaluating the audit procedures with all EAGs. The trial audit runs will include the execution of the audit procedures by the EAGs at a few local radiotherapy hospitals.

A specific set of written guidelines, including methodology/action plan to perform the quality audits, as well as guidelines for the evaluation of these audits for radiation dosimetry in the specified complex treatment situations, will be developed and adapted to local circumstances of each CRP participating country. These will include operating procedures for megavoltage photon beam dosimetry quality audits and the design of instruction sheets, irradiation forms and results reporting forms.

A set of extensively tested phantoms capable of assessing an institution's radiation dosimetry practices for megavoltage photon beams for MLC-shaped fields and heterogeneity, will be available. Expertise and technology developed under this CRP will be validated by the national networks and will be available for transfer to other Member States.

The expected research outcome of this CRP is to increase radiation dosimetry expertise internationally in order to potentially reduce the number of misadministrations of dose to radiotherapy patients. It will provide improved confidence in the introduction of these more complex technologies and treatments in countries involved in the CRP.

The project will also provide a benefit to other countries who are interested to develop a national dosimetry network of their own. There will be direct experience gained and made available, regarding the practical methods and procedures involved in extending measurements to the complex parameters included in this project. In addition, the present network experience will be extended to include this new activity, and provide a base for the sharing of lessons learned from future experiences and results. The methods and the tools required for the dosimetry audit can then be adapted by other national networks in a straightforward manner.

Steps in dosimetry audits of complex treatments

Six increasingly complex dosimetry audit steps are involved in the national audit programmes. Steps 1-3 have been developed under the previous CRPs and steps 4-6 are the subject of research under the present CRP. These steps are explained below.

Steps 1 - 3. TLD audits for photon beams in reference and non-reference conditions

It is desirable that any radiotherapy centre newly entering the audit process to successfully implement steps 1 – 3 before considering any subsequent steps and it is required that they have completed steps 1 – 2.

- Step 1 outlines a TLD quality audit programme for photon dosimetry under reference conditions as recommended by Technical Reports Series No. 398 [2].
- Step 2 is an extension of step 1 and outlines a TLD quality audit programme for photon dosimetry under both reference and non-reference conditions where only 'on beam axis' dosimetry parameters are verified. These dosimetry parameters include reference point output calibration, variation of output with field size and dose variation with wedges including field size dependence of the wedge transmission factor.
- Step 3 is an extension of step 2 and outlines a TLD quality audit programme for photon dosimetry under reference and non-reference conditions where 'off beam axis' dosimetry parameters are verified [3]. These 'off beam axis' dosimetry parameters include open field profiles at 2 off axis points - inplane and crossplane, wedge field profile at 2 off axis points along the direction of the wedge slope, asymmetric open field profile at 5 cm from the collimator axis, and asymmetric wedged field profile.

As a logical extension of the previous 3 quality audit steps, the following quality audit steps 4 – 6 are designed to verify whether radiotherapy centres can correctly calculate the absorbed dose for fields shaped with an MLC, calculate the absorbed dose in the presence of heterogeneities and incorporate accurate dose profiles in their treatment planning system (TPS).

Step 4. TLD quality audits for photon beams shaped with an MLC

If a national EAG has successfully implemented steps 1 – 2 and if they have chosen to continue with photon beam complex treatment audits as their next priority, then they can proceed to step 4.

For the step 4 audit it is proposed to include measured checks of dose variation with specific field sizes and shapes defined by an MLC at 10 cm depth in water, including the use of a wedge for one of the MLC shapes. There are seven various field sizes and shapes defined by the MLC. These parameters have been selected for this step in order to utilize the existing IAEA standard TLD holder with minimum modification at minimum cost, allowing relatively rapid implementation in the participating countries. These dose checks are necessary to identify and correct potential deviations in MLC dosimetry and largely follow the previous experience from the ESTRO/EQUAL quality audit programme [4].

Participating hospitals will be requested to provide TPS calculated absorbed dose values at a depth of 10 cm in water for each of the MLC shapes identified above in order to allow the auditors to evaluate the consistency of data in clinical use by comparing the calculated doses to the measured dose values determined with the TLD quality audit.

This quality audit step is intended to be carried out by all hospitals, for those selected photon beams used most often clinically.

Step 5. TLD quality audit for photon beams in the presence of heterogeneities

If a national EAG has successfully implemented step 4 and if they have chosen to continue with photon beam complex treatment audits as their next priority, then they can proceed to step 5.

For the step 5 audit it is proposed to include checks of dose calculation in the presence of two heterogeneities, lung and bone, at a physical depth of 10 cm in a polystyrene phantom as shown in Figure 1. This phantom will accommodate TLD on the central axis (see Figure 1). In addition to the polystyrene slabs, a slab of lung equivalent material and a slab of bone equivalent material will be included. The three solid phantom configurations, polystyrene only, polystyrene plus lung equivalent material and polystyrene plus bone equivalent material, will all be imaged with a CT scanner and the images exported to the TPS. The TLD measured absorbed doses will be compared to the dose calculations from the hospital's TPS for each of the phantom setups at the location of the TLD.

This step is intended to be carried out in all hospitals and for the photon beam energy most often used clinically for treatments in the thorax. The same energy must be used for the bone heterogeneity test.

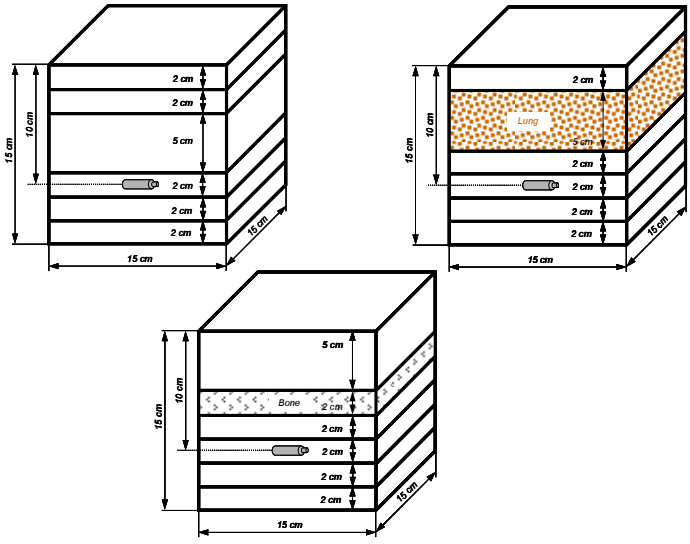

Figure 1. Polystyrene/heterogeneity solid phantom configurations for the quality audit of complex treatments. A TLD is positioned on a central axis of the beam.

Step 6. TLD and film 2D profile quality audit for small photon MLC shaped field sizes

This step includes checks of the dose profile in the in-plane and cross-plane directions, specifically the penumbra region, for two field sizes shaped with the MLC, at a physical depth of 10 cm in the polystyrene phantom used in step 5 as shown in Figure 2.

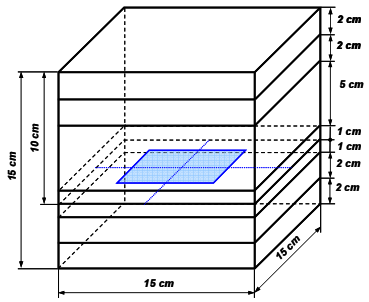

Figure 2. Polystyrene solid phantom with film configuration for the quality audit of complex treatments.

Radiochromic film will be used to perform this quality audit. The film analysis methodology will include handling of the film, irradiation of the film with known reference points marked on the film, scanning of the irradiated film with a flatbed scanner, and creating relative dose profiles normalized to the central axis value from the measured and TPS calculated dose values. The measured dose profiles will be compared to the dose distribution determined by the TPS in the same planes of calculation as determined with the radiochromic film.

This step is intended to be carried out in all radiotherapy centres in a country for photon energies most commonly used in the clinic with MLC shaped fields.

The first Research Coordination Meeting (RCM)

The first RCM took place on 10-12 June 2009 in Vienna. The meeting was dedicated to the discussion of the research strategy for the duration of the CRP 2009-2011, including development of the methodology and the action plan for TLD audits for complex treatment techniques in radiotherapy.

The working schedules for the participants were coordinated and goals to be achieved outlined with regard to the subsequent implementation steps of the national QA programmes. In particular, the general procedure for MLC beam checks on-axis has been reviewed and a schedule was established for a multicentre pilot study. At the same time, procedures for heterogeneity checks were discussed. Special attention was given to 2D dosimetry and the necessity of expanding the EAGs expertise towards the radiochromic film dosimetry. It was concluded that it is necessary for the EAG composition to evolve in order to adjust the scope of dosimetry audits by national EAGs to radiotherapy techniques used in clinics.

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Participants in the first RCM, 10-12 June 2009, Vienna. Left to right: Helena Zackova (Czech Republic), Ahmed Meghzifene (IAEA), Dietmar Georg (Austria), David Followill (USA), Joanna Izewska (IAEA, Scientific Secretary), Amalia Stefanic (Argentina), Luo Suming (China), Tomislav Bokulic (IAEA), Wojciech Bulski (Poland), Claudio Viegas (Brazil), David Thwaites (UK) (courtesy of E. Izewski).

Consultants Meeting on Development of a Guidance Document on Radiation Protection Calibrations at Secondary Standards Dosimetry Laboratories

15-18 June 2009
Vienna, Austria

Participants of the meeting.

The purpose of the meeting was to discuss methodologies for calibration of various radiation protection instruments, decide those areas of calibration that need to be addressed in the IAEA guidance document, identify potential contributors and start drafting the document. The main target group is members of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories. The document could be used also by other laboratories providing calibrations of radiation protection instrumentation.

Discussions were held on calibrations of radiation protection instruments with respect to their application and radiation types. It was agreed that the document should focus on following topics:

- Calibration of photon measuring instruments;
- Calibration of instruments measuring beta radiation;
- Calibration of neutron measuring instruments;
- Calibration of surface contamination measuring instruments.

In addition, the document should contain the necessary information on fundamentals of calibration, uncertainty assessment and quality management system in the calibration laboratory.

The document structure was drafted and inputs for various chapters discussed. On the last day of the meeting, the consultants were split into four groups and worked on the drafting of the document. Their contributions were jointly reviewed and merged into one single document (a copy of the draft is available from the DMRP Section).

The strategies for writing the document chapters were discussed and personnel responsible for their development were assigned. A timeline for the document development was also prepared. It assumes a completion of the first draft for comments by contributors by the end of 2009.

Recommendations

It was recommended that:

- The next meeting is held in May/June 2010 to review the draft document and identify needs for improvement. The document should be ready for external review in autumn 2010;
- After review, submit for publication.

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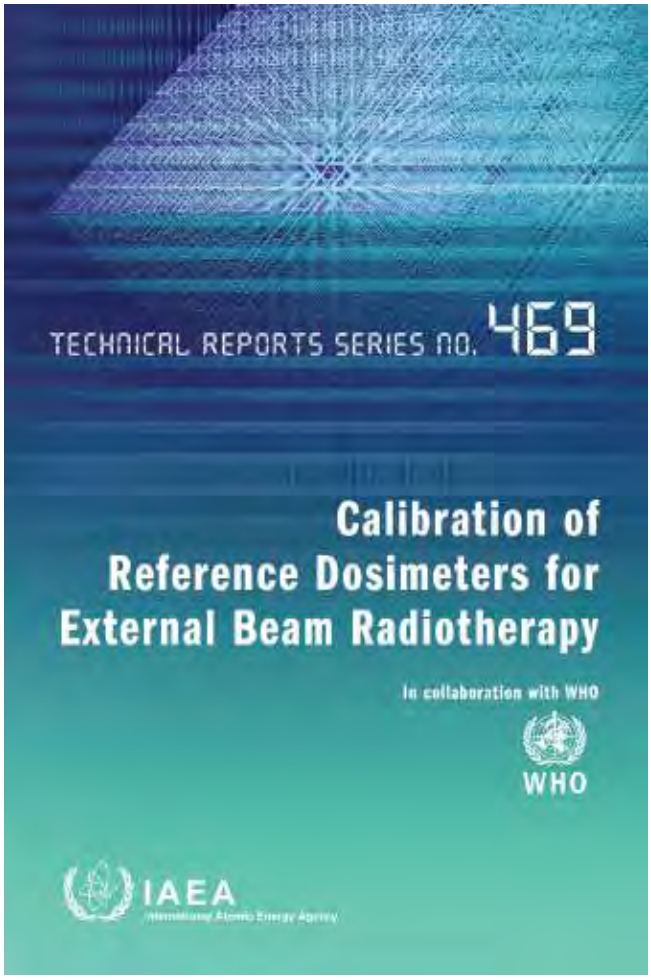
Calibration of Reference Dosimeters for External Beam Radiotherapy



Traceability, accuracy and consistency of radiation measurements are essential in radiation dosimetry, particularly in radiotherapy, where the outcome of treatments is highly dependent on the radiation dose delivered to patients. The role of Secondary Standards Dosimetry Laboratories (SSDLs) is crucial in providing traceable calibrations to hospitals, since they disseminate calibrations at specific radiation qualities appropriate to the use of radiation measuring instruments.

To provide SSDLs with a practical guide on calibration and quality control procedures in radiotherapy dosimetry, the IAEA published a manual in 1995 entitled Calibration of Dosimeters Used in Radiotherapy (Technical Reports Series (TRS) No. 374). The manual was a revision of a report, Calibration of Dose Meters Used in Radiotherapy (Technical Reports Series No. 185), published in 1979. Although much of Technical Reports Series No. 374 remains relevant, there are a number of reasons for preparing a new report, including the development of new dosimetry standards and an increased emphasis on implementing quality assurance systems to help calibration laboratories provide documented assurance to the user community of their commitment to offering consistent and reliable results.

This report is not simply a revision of Technical Reports Series No. 374, but should be regarded as a new publication with a new structure.

Nevertheless, some material, especially that related to the calibration of dosimeters in terms of air kerma for kilovoltage X rays, has been extracted from Technical Reports Series No. 374. It fulfils the need for a systematic and standardized approach to the calibration of reference dosimeters used in external beam radiotherapy by the SSDLs. It provides a framework for the operation of an SSDL within the international measurement system, a methodology for the calibration of instruments, and related quality control procedures to ensure traceability of radiation measurements in external beam radiotherapy. This report is intended mainly for SSDLs, but the information is also useful for similar laboratories involved in the calibration of dosimeters used in external radiotherapy.

The report can be downloaded from:

http://www-pub.iaea.org/MTCD/publications/PDF/trs469_web.pdf

The Fifth Conference of the African Radiation Oncology Group (AFROG)

In collaboration with International Atomic Energy Agency (IAEA)

AFROG V Conference

'Quality Assurance in New Technologies'

Harare, Zimbabwe, 10-11 December 2009

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IAEA Publications in the field of dosimetry and medical physics

2009 Calibration of Reference Dosimeters for External Beam Radiotherapy, (TRS 469). http://www-pub.iaea.org/MTCD/publications/PDF/trs469_web.pdf

2008 Transition from 2-D Radiotherapy to 3-D Conformal and Intensity Modulated Radiotherapy (IAEA-TECDOC-1588). http://www-pub.iaea.org/MTCD/publications/PDF/TE_1588_web.pdf.

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Courses, Meetings and Consultancies in 2009

Courses and workshops

Regional (AFRA) Training Course on Implementation of 3-D-Conformal Radiotherapy, Cairo, Egypt, 17-22 October 2009 (RAF/6/031 and RAF/6/035)

Regional (AFRA) training course: Hands-on course on performing an acceptance test of a dual-head gamma-camera, Gamma-camera Laboratory at IAEA's Seibersdorf Laboratories, 19-23 October 2009 (RAF/6/032)

Regional (AFRA) Training Course on Implementation of IAEA TRS 430 on Quality Assurance for Radiotherapy Treatment Planning Systems, Alger, Algeria, 8-12 November 2009 (RAF/6/031)

IAEA supported ESMP Training Course on Brachytherapy, Archamps, France, 12-17 November 2009

IAEA supported ESTRO Teaching Course on IMRT and Other Conformal Techniques in Practice, Gliwice, Poland, 15-19 November 2009

Meetings and consultancies

Consultants Meeting on Harmonisation of Quality Assurance in Digital Mammography, IAEA, Vienna, Austria, 4-7 August 2009

Consultants Meeting to formulate detailed proposal for a CRP on advanced dosimetry in diagnostic radiology, IAEA, Vienna, Austria, 28 September-1 October 2009

Technical Meeting to prepare educational material on implementation of 3D-CRT, IAEA, Vienna, 14-16 October 2009

Consultants Meeting to develop standards required for effective use of digital imaging and teleradiology in Member States (in collaboration with WHO), IAEA, Vienna, Austria, 14-17 December 2009

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