



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

Vienna, Austria
9-12 November 2010

Organized by the
International Atomic Energy Agency

In cooperation with the
American Association of Physicists in Medicine (AAPM)
Asia-Oceania Federation of Organization for Medical Physics (AFOMP)
Latin American Association of Medical Physics (ALFIM)
International Bureau of Weights and Measures (BIPM)
European Commission (EC)
European Federation of Organizations for Medical Physics (EFOMP)
European Society for Therapeutic Radiology and Oncology (ESTRO)
International Commission on Radiological Protection (ICRP)
International Commission on Radiation Units and Measurements, Inc (ICRU)
International Organization for Medical Physics (IOMP)
Institute of Physics and Engineering in Medicine (IPEM)
Society of Nuclear Medicine (SNM)
United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
World Federation of Nuclear Medicine and Biology (WFNMB)

1. INTRODUCTION

Background

The objective of the IAEA programme in human health is to enhance the capabilities in Member States to address needs related to the prevention, diagnosis and treatment of health problems through the application of nuclear techniques. The mandate arises from Article II of the IAEA's Statute: *“the Agency shall accelerate and enlarge the contribution of atomic energy to health, peace and prosperity throughout the world”*.

Accurate measurements in radiation dosimetry are vital in a wide range of medical and industrial applications where the results of measurements are critical in decisions relating to human health and safety of radiation workers and members of the public. The development of

standards by primary dosimetry laboratories followed by their dissemination to secondary standards dosimetry laboratories and to end-users ensures traceability of measurements to the international system of units (SI). Dosimetry codes of practice (or protocols) are used in conjunction with the dosimetry standards to ensure optimized use of radiation in medicine. Uniformity is equally important in dosimetry, especially for collaborative multi-centre studies or clinical trials.

In radiation protection, the uncertainty in the dosimetry may be greater than for therapy and diagnostic X rays, but proper traceability of the measurements with a defined level of uncertainty is equally as important. In recent years, new developments have occurred in dosimetry standards, audits and QA guidance, especially in the field of external radiotherapy, brachytherapy, nuclear medicine and diagnostic radiology.

There is a need for scientific exchange at international level and review of status of dosimetry and applications in medical dosimetry.

Objectives

The major goal of the symposium is to provide a forum where advances in radiation dosimetry during the last decade, in radiation medicine and radiation protection 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 the recent years (brachytherapy, diagnostic radiology and nuclear medicine). It will also summarize the present status and 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.

Target audience

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 including intravascular techniques, diagnostic radiology including CT, mammography and interventional procedures, nuclear medicine and radiation protection dosimetry.

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

Programme Structure

The symposium will consist of 16 sessions: four sessions per day of approx. 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 followed by at least one keynote presentation that will discuss the *accuracy requirements in medical radiation dosimetry*, in 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 application 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.

On day 3, a session will be dedicated to 3 **round-table discussions**, one in each field.

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

2. TOPICS

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)
 - 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, TRS-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 (IMRT 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 (TRS-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 (Intra-operative 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 (TRS-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 correction factors
 - Proton radiography
 - Patient specific dosimetry and PET
 - Neutrons and out of field dosimetry

3. PAPERS/POSTERS AND SYMPOSIUM PROCEEDINGS

Concise papers on issues falling within the topics outlined in Section 2 may be submitted as contributions to the symposium. All papers, apart from invited review papers, must present original work; they should not have been published elsewhere.

(a) Submission of Synopses

Persons who wish to present a paper or poster at the symposium must submit a two page synopsis of about 800 words (in English) together with the completed Participation Form (**Form A**) and Paper Submission Form (**Form B**) as indicated in Section 9 'Channels of communication and deadlines' by **16 April 2010**.

The instructions and specifications on how to prepare the synopsis, how to access and use the template and how to submit it electronically are given in the attachment. Also attached is a "Sample Extended Synopsis".

The synopsis will be considered by the Programme Committee only if **Form A** and **Form B** have been sent to the competent official authority of the participant's country (see Section 9) for transmission to the IAEA.

(b) Acceptance of papers/posters

Given the number of papers anticipated and the need to provide ample time for discussion, the number of papers that can be accepted for oral presentation is limited. Authors who would prefer to present a poster are requested to indicate this preference on the participation form (Form A).

Authors will be notified by the end of **May 2010** whether their papers have been accepted by the Programme Committee for oral presentation or for presentation as a poster. Following acceptance of their paper they will be informed of the assigned paper/poster number and the session of presentation. All of the accepted synopses will be reproduced in unedited form in the “Book of Extended Synopses” which will be distributed to all participants at registration.

(c) Submission of full manuscripts

Instructions and guidelines on how to submit the full manuscript will be sent to all authors of accepted papers/posters and will also be available on the symposium website by the end of May 2010.

(d) Proceedings

Proceedings will be published as soon as possible after the symposium.

4. PARTICIPATION

All persons wishing to participate in the symposium are requested to **register in advance online** via the symposium web site:

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

In addition, they must submit Participation Form (Form A) as indicated in Section 9 ‘Channels of Communication and deadlines’. A participant will be accepted only if Form A is transmitted through the competent official authority of a Member State of the IAEA or by an organization invited to participate.

Participants whose designations have been received by the IAEA will be notified directly approximately three months before the symposium.

5. EXPENDITURES

No registration fee is charged to participants.

As a general rule, the IAEA does not pay the cost of attendance (i.e. travel and living expenses) of participants. However, limited funds are available to help meet the cost of the attendance of selected **specialists mainly from developing countries with low economic resources**. Selection preference will be given to applicants with an accepted paper or poster. The grants will be lump sums usually covering **only part of the cost** of attendance. Generally, not more than one grant will be awarded to any one country.

To apply for a travel grant, please submit the Grant Application Form (Form C) together with the Participation Form (Form A) as indicated in Section 9 'Channels of Communication and deadlines' **by 31 May 2010**. Incomplete or late applications cannot be considered.

6. WORKING LANGUAGE

The working language of the symposium will be English. All communications, synopsis, abstracts and papers sent to the IAEA must therefore be in English.

7. ACCOMMODATION

Detailed information on accommodation and other administrative details will be sent to all designated participants well in advance of the symposium. This information will also be available on the symposium website.

8. VISA

Designated participants who require a visa to enter Austria should submit the necessary application to the nearest diplomatic or consular representative of Austria at least **4 weeks** before entry into Austria. Please note that Austria is a Schengen State and therefore persons who require a visa will have to apply for a 'Schengen visa'. In States where Austria has no diplomatic mission, visas can be obtained from the consular authority of a Schengen Partner State representing Austria in the country in question.

9. CHANNELS OF COMMUNICATION AND DEADLINES

As applicable, the following forms must be sent to the competent official authority of the participant's country (i.e. Ministry of Foreign Affairs or national atomic energy authority) or to an organization invited to participate for onward transmission to the IAEA:

- Form A: Participation Form
- Form B: Form for Submission of a Paper/Poster plus one hard copy of the synopsis by **16 April 2010**

In addition, the synopsis should be sent electronically to the IAEA Scientific Secretariat, email: **symposium.dosimetry@iaea.org**

- Form C: Grant Application Form by **31 May 2010**

Subsequent correspondence on **scientific matters** should be sent to the IAEA Scientific Secretary and correspondence on **administrative matters** to the IAEA Conference Coordinator.

11. IAEA SECRETARIAT:

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12. SYMPOSIUM WEB PAGE

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

INSTRUCTIONS

HOW TO PREPARE THE SYNOPSIS:

Anyone wishing to present a paper at the symposium is requested to submit a synopsis of not more than 800 words. The synopsis should give enough information on the contents of the proposed paper to enable the Programme Committee to evaluate it. Introductory and general matters should not be included.

HOW TO SUBMIT THE SYNOPSIS:

The synopsis must be submitted as indicated in the Announcement under section 9 'Channels of Communication'. Deadline is 30 April 2010.

HOW TO USE THE SYNOPSIS TEMPLATE

Authors are urged to make use of the Synopsis Template in Word 2000 and the user instructions available on the symposium web site:

<http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=38089>

- Right-click on the template link and select "Save Target As" from the menu; save the template in the standard templates folder (the location can be found in Word under "Tools/Options/File Locations/User templates").
- To create a new document using this template in MS Word, choose "File/New" and select "IAEA Synopsis" under the "General" tab.
- Select "Create New Document" and click on the "OK" button. (Please note that the template will not work if opened using "File/Open".)

Synopsis properties:

When a new document is created, the initial dialog box (called "*Synopsis Properties*") will appear on your screen and should be filled out as directed. In case of more than one institute, each institute should be a "New" entry. For each author, select the appropriate institute. When the "OK" button on the dialog box is clicked, the information entered is saved and inserted at the appropriate places in the paper.

The dialog box can be recalled from the "IAEA Synopsis" dropdown menu on the "Standard" toolbar under "*Show Synopsis Properties*" and the information in it altered. Note: All the items available in the "IAEA Synopsis" menu are also available as separate toolbar buttons.

Check fonts: Use this function to detect and replace non-compliant fonts.

Bullets and numbers: The template provides predefined bullet and numbered lists.

UNABLE TO USE THE TEMPLATE?

USE THE FOLLOWING LAYOUT:

Page size: A4 (21 cm × 29.7 cm) – vertical (portrait) orientation

Margins: Left/right: 2.5 cm; top: 2 cm; bottom: 2.7 cm

Line spacing: Single

Justification: Full

Font: Times New Roman only

Point size: Title: 14 point bold; authors: 12 point bold; affiliation, and main text: 12 point

Length: Maximum 2 pages (800 words)

Use of ^{137}Cs Calibration Source in Evaluation of BWR Fuel Burnup

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A method for evaluating the burnup (BU) of BWR spent fuel was investigated by using a novel type of ^{137}Cs calibration source. The source is constructed to fit in the fuel handling fixtures of all the BWR type power plants in Sweden and Finland. It can be used also in the interim storage facilities for spent fuel, CLAB in Sweden and TVO-KPA-STORE in Finland.

The source is covered by a watertight steel cylinder which is fixed inside a 0.65 m long section of ASEA-ATOM type BWR fuel channel. Inside the cylinder there is a 37 GBq ^{137}Cs pellet fixed to a wagon which can be driven up and down by means of a stepping motor. By moving the source, the repeatability of the geometrical positioning is attained. The amplitude and scanning speed are controlled by a remote control unit. The apparatus is easy to handle and decontaminate. The source can be transported in a custom made box (45 cm × 45 cm × 70 cm) under category II-Yellow. In repeated measurements the precision of the new calibration source was found to be 11.7%. Use of this calibration source makes it possible to calibrate the whole measurement chain and to compare the data measured in different geometries. A typical calibration time is 15 min including source handling.

In recent measurements, a Westphal loss free counting (LFC) system was used in connection with an ND66 multi channel analyser for scanning of fuel assemblies. By use of LFC, real time correction of counting losses is performed.

For BU verification 21 assemblies with mean BUs from 14 to 31 MW·d/kg U and cooling times from 200 to 1500 d were scanned on each of the four corners. The total time needed per assembly was typically half an hour. The ^{137}Cs measurement data were corrected for radioactive decay, self-absorption and inhomogeneous Cs distribution. By use of the arithmetic mean for the four corners and the earlier defined relation between BWR fuel BU and ^{137}Cs activity [1], the BU could be calculated.

The BU calculated from the measured data is shown plotted against the declared BU in Fig. 1. Error bars reflect the precision of measurements for single assemblies. The ±5% deviation lines are also plotted. A more detailed description of the method will be published elsewhere [2].

The measurement system has been developed to be used by the Swedish and Finnish national safeguards authorities for verification of spent fuel BU.

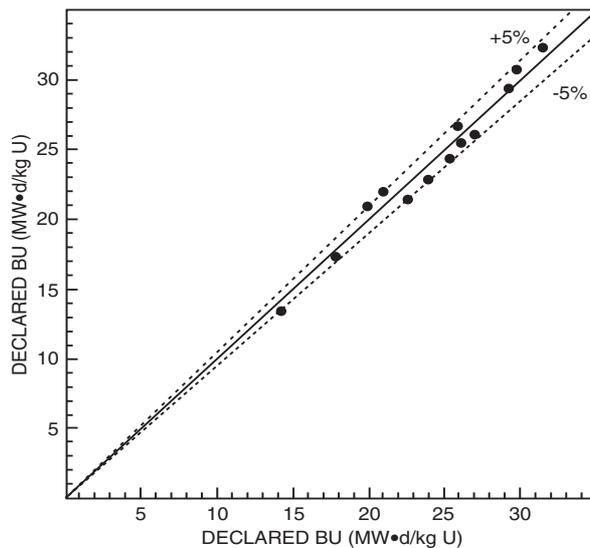


FIG. 1. Operator declared BU compared with the calculated BU values based on the ^{137}Cs activity measurements.

- [1] EKENSTAM, G., Cs^{137} measurements of spent BWR fuel", Safeguards and Nuclear Material Management (Proc.6th ESARDA Annual Symp. Venice, 1984), CEC Joint Research Centre, Ispra (1984) 327-330.
- [2] EKENSTAM, G., TARVAINEN, M., Verification of Burnup of BWR-type Nuclear Fuel by Measurement of the Cs^{137} Acitivity, Rep.STUK-A52, Finnish Centre for Radiation and Nuclear Safety, Helsinki (in press).