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Contents

From the Editor

Mr Rethy Kieth Chhem left the IAEA on 31 August 2014, after completing nearly 6 successful years as Director of the Division of Human Health. Ms May Abdel-Wahab was appointed as the new Director from October 2014. She has over 30 years of patient care, teaching and research experience in the field of radiation medicine. Before joining the IAEA she was section head of GI Radiation Oncology at the Cleveland Clinic, USA and Professor at the Cleveland Clinic Lerner School of Medicine, Case Western University.

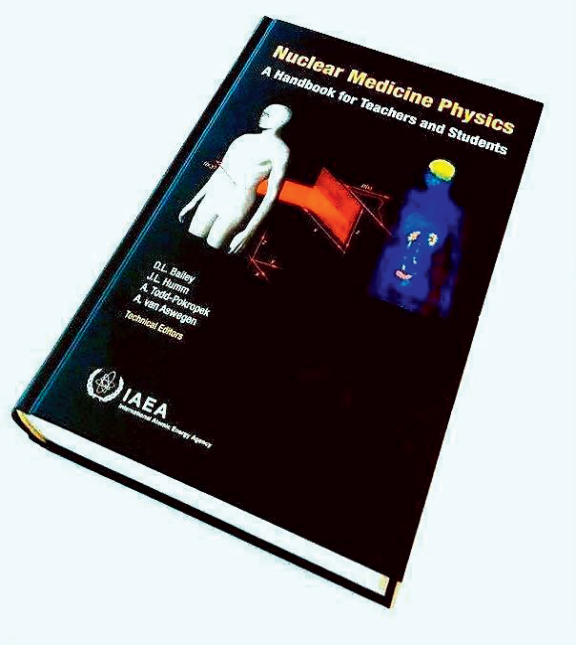
This issue of the SSDL Newsletter contains two meeting reports. The first one describes the 16th Scientific Committee of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories, held at the IAEA Headquarters in March 2014. The second report is prepared from a consultants' meeting on "Development of a Training Programme for Secondary Standards Dosimetry Laboratories", held at the IAEA in May 2014.

The next contribution is a report of a new IAEA/RCA Regional Project in Medical Physics Education and Training for the Asian region, held at the IAEA in May 2014.

An overview of the new IAEA publication on "Diagnostic Radiology Physics: A Handbook for Teachers and Students" is presented in the last article.

Recently the IAEA completed series of Medical Physics Handbooks with the publication of "Nuclear Medicine Physics: A Handbook for Teachers and Students".

The IAEA's Dosimetry and Medical Radiation Physics Section welcomes a new staff member: Ms Karen Christaki, from United Kingdom, who is a clinical medical physicist in radiation therapy.



Nuclear Medicine Physics: A Handbook for Teachers and Students, published in December 2014

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

The IAEA CMCs 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
Comparison of therapy level ionization chamber calibrations coefficients 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

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 at the web site: http://www-naweb.iaea.org/nahu/dmrp/SSDL/default.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.

Scientific Committee of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories

Report of the Sixteenth Meeting of the SSDL Scientific Committee

IAEA, Vienna, 10–14 March 2014

1. Foreword

The Scientific Committee of the IAEA/WHO network of Secondary Standards Dosimetry Laboratories (SSDLs) is a standing committee (SSC) within the framework of the International Atomic Energy Agency. It is tasked with conducting periodic reviews and evaluations of the Dosimetry and Medical Radiation Physics (DMRP) Subprogramme and reporting the results of the reviews to the Directors General of the IAEA and the WHO. The report of the fifteenth meeting (held in March 2012) of the previous SSC was published in the SSDL Newsletter No. 61 in June 2013.

The sixteenth meeting was held in Vienna at the Agency Headquarters from 10 to 14 March 2014. Opening remarks were made by Mr R. Chhem, Director of the Division of Human Health (NAHU) and acting Deputy Director General for the Department of Nuclear Sciences and Applications; Ms María Pérez, on behalf of Ms Adriana Vélazquez Berumen, the Co-Secretary of the IAEA/WHO SSDL Network (World Health Organization); and Mr A. Meghzifene, Head of the Section of Dosimetry and Medical Radiation Physics and Co-Secretary of the IAEA/WHO SSDL Network. Members of the SSC-16 are: Mr David T. Burns, Ionizing Radiation Department, International Bureau of Weights and Measures (BIPM), Sèvres, Ms María-Ester Brandan, Instituto de Física, National University of Mexico (UNAM), Mr David S. Followill, MD Anderson Cancer Center, USA, Mr Konstantinos Hourdakis, Ionizing Radiation Calibration Laboratory, Greek Atomic Energy Commission, Greece, Mr Hans-Georg Menzel, (Chairman) ICRU Bethesda, Mr Carl Ross, Ionizing Radiation Standards Group, National Research Council, Canada, Mr George Sgouros, Division of Nuclear Medicine, Johns Hopkins University, USA and Ms Adriana Vélazquez Berumen, Diagnostic Imaging and Medical Devices, World Health Organization, Geneva.

1.1. Introductions

Mr Ahmed Meghzifene, Head of the DMRP, opened the 16th biennial meeting of the SSC and welcomed all the new members noting they were charged with providing advice to the Agency on the work programme of the DMRP. Mr Rethy Chhem, the Director of the Division of Human Health and Acting Deputy Director General for Nuclear Sciences and Applications, in Mr Mohamed Daud's absence, added his words of welcome noting that the SSC is a highly relevant advisory group on the Agency's activities in medical physics. He particularly welcomed the WHO representative and thanked the previous SSC-15 for their work and support of the DMRP programme. Mr Chhem explained that although he had studied some physics he then switched to medicine and so was able to view the Human Health Division from both aspects. He looked forward to the Committee's advice on the programme and encouraged new and innovative ideas saying that Medical Physics is a top priority for the Agency which is investing heavily in the renovation of the Agency Laboratory at Seibersdorf under a special project entitled ReNuAL. His particular background is in Diagnostic Imaging and there is strong collaboration between the Nuclear Medicine and Diagnostic Imaging and DMRP sections in the Division. He hoped that the new membership of the SSC-16 would give a boost to the Committee and provide exciting fresh ideas and recommendations towards strategic thinking during the week's work.

Ms María Pérez introduced herself and expressed her pleasure and honour to be representing the WHO at the SSC-16, noting that she was bringing in her words of welcome the joint voice of WHO and AMRO/PAHO. She explained that Ms Adriana Velazquez, the Joint Secretary of the SSDL Network, might be able to join the Committee on Thursday to discuss the various recommendations. She said that the WHO supported the many advances in health care using ionizing radiation over the past several years and that the treatment of non-communicable disease such as cancer is a special

objective of the WHO. Ms Pérez continued by saying that the WHO is very supportive of the DMRP programme, as quality audits in medicine and particularly dosimetry lead to the highest standards of treatment. The WHO, being a co-sponsor of the new international Basic Safety Standards for ionizing radiation (BSS), is well aware of the many new safety requirements for medical exposures that are included in the BSS. The Agency's DMRP programme is a key component of quality audits and the IAEA/WHO Network detects and prevents serious dosimetry errors, with the independent calibration of the measurement equipment. She expressed the view that the committee work is a challenge and wished the SSC-16 members a very successful meeting.

Mr Meghzifene then introduced himself and his additional role as Joint Secretary of the SSDL Network. He explained that the SSC had been created in 1986 to advise on the work for the Network and, later, the terms of reference had been expanded to include all aspects of the work programme in dosimetry and medical radiation physics, encompassing protocols and training, within the more general framework. He said that having representatives from the WHO, the ICRU and the BIPM on the SSC is key in supporting the appropriate activities of the SSDL network.

Mr Meghzifene then outlined the structure of the meeting which would include presentations by the staff on the 2012/13 programme and an introduction by himself on the programme for 2014/15 that had been formulated with the advice of the SSC-15. There would be a visit to Seibersdorf, which would include the Gamma Camera facility as well as the Dosimetry Laboratory. Finally he would present the outcome of the brainstorming session with his staff for the SSC-16 to consider in their recommendations for the 2016/17 programme. He requested that the SSC-16 use a prioritization scheme in terms of high, medium and low priority for each recommendation and any additional comments on the programme would also be acknowledged and implemented where appropriate. He had appreciated the work of the SSC-15 and explained that, once the SSC-16 report had been submitted and approved by the Director General (DG), the programme would be finalized and implementation could start. He expressed his thanks to Mr Hans Menzel who would Chair the meeting and to Penelope Allisy who would act as Rapporteur.

Mr Hans Menzel thanked Mr Meghzifene saying it was a pleasure, an honour and somewhat of a challenge to chair the SSC which has a long-standing association with the ICRU, of which he is currently Chairman. Some of the ICRU work is in imaging as well as dosimetry, for example in CT for which a report produced under the leadership of Mr John Boone has just been published; there is also a report in a final stage of preparation on key data for measurement standards in the dosimetry of ionizing radiation due to be published soon that has the involvement of Messrs Carl Ross and David Burns and another report on small field dosimetry is also near completion, all of which illustrates the close relationship between the topics of interest to the ICRU and the IAEA. He concluded by thanking the WHO and Mr Chhem for their continued support.

The Chairman presented the agenda explaining that it represented a full week's work, and the agenda was then duly adopted.

1.2. General discussion

1.2.1. Programme of the Meeting

Mr Meghzifene began the meeting with an overview of the complete sub-programme of the DMRP for 2012-2013, illustrating how it fits into the overall framework of the Division that follows the Agency mandate on human health. He stressed the special importance of the Technical Cooperation Department (TC) in enabling Member States to obtain access to facilities and resources to build and improve their own programmes with the assistance of the IAEA. Indeed the Programme of Action for Cancer Therapy (PACT) project of the Agency had been moved into TC since 1 January 2014. Requests for TC support are made by Member States to the Agency and, if approved, are then funded from the TC budget. However, not all countries are eligible and low and middle income countries generally have priority. The DMRP has a considerable input into TC projects and with the support of the SSC has achieved two new posts over the past ten years. Consultants are also proposed to support TC projects for Member States. In response to a further question, Mr Meghzifene said that whenever possible and within workload constraints, TC projects were operated in collaboration with other sections in the Division. Such collaborations also encouraged the Member State to consider the benefits of similar collaboration at a local level.

Mr Meghzifene then reported the actions following the SSC-15 recommendations. This was followed during the remainder of the first day of the meeting by DMRP staff members presenting reports on the activities of the Section. These reports continued into the morning of the second day. In the afternoon of the second day, the SSC-16 was taken to Seibersdorf where three further presentations were made by staff on the laboratory's scope of work and the SSC-16 was able to see the laboratories and work at first hand, including the Gamma Camera Laboratory. On the third day there was a wrap-up session on the DMRP activities and then the SSC-16 met in closed session, deliberating on the accomplishments and direction of the DMRP's sub-programme, and developing specific recommendations for the current DMRP projects/tasks and those projected to the next biennium. Discussion continued on the draft

recommendations and their prioritization on the fourth day. The main draft recommendations were discussed with Mr Meghzifene, and presented to the DMRP staff on the afternoon of the last day. During the feedback, the Chairman of the SSC-16 thanked the DMRP staff for their very full report and for their carefully prepared presentations.

1.2.2. Programme Evaluation

In preparation for its report, the SSC-16 reviewed the activities reported by the DMRP for the 2012-2013 biennium, the outcome of the recommendations made by the SSC-15 and discussed and made some recommendations concerning the planned sub-programme activities for 2014–2015. The SSC also reviewed the results of the DMRP's "brainstorming" for the biennium 2016–2017 and presented some recommendations for the future activities. The SSC-16 evaluation was similar to that of previous SSCs and considered:

- The objectives of the sub-programme areas.
- The impact (benefit to the Member States).
- Opportunities to reduce costs.
- The continuing relevance of Agency activities.

Specific recommendations from the SSC-16 are identified throughout the text, and are also listed in priority categories of high, medium and low at the end of the report. The numbering of the recommendations and their wording follows that submitted in April in the form of a short report following the SSC-16 meeting. Comments regarding specific aspects of the DMRP sub-programme are made throughout the text and the more important comments are also given at the end of the report.

2. Introduction

The SSC-16 expressed their thanks to the DMRP staff members for preparing a comprehensive report covering the activities of the sub-programme on Dosimetry and Medical Radiation Physics during the biennium 2012-2013. This report was provided well in advance of the meeting, enhancing the Committee's ability to develop relevant recommendations.

The SSC-16 was pleased to learn that thirteen of the SSC-15's recommendations had been fully implemented and the remaining ten were in progress and due to be completed during the present biennium. Mr Meghzifene noted that the project-specific comments of the SSC-15 had been helpful and twelve of these had actually been implemented, a further three were in progress or under consideration, while the remaining four had been noted as no action being needed, as detailed in the written DMRP report.

During the biennium 2012-2013, the DMRP Section projects and titles were:

- Project 2.2.4.1: Quality audits in dosimetry for radiation therapy
- Project 2.2.4.2: Supporting traceability of measurements in radiation medicine
- Project 2.2.4.3: Quality assurance and guidelines for medical physics in clinical radiation imaging
- Project 2.2.4.4: Development and harmonization of quality assurance in radiation medicine

However, with effect for the 2014-2015 biennium, the SSC-16 noted that the programme had reduced the number of DMRP projects from four to three by grouping all the Dosimetry Laboratory associated activities into one project, combining all the research and development activities in dosimetry as a second project, and combining all the clinical medical physics activities, including imaging and radiation therapy, into a third project. Consequently, this new project grouping, as follows, is used in the present report:

- Project 2.2.4.1: Calibration and auditing service
- Project 2.2.4.2: Developments in radiation dosimetry
- Project 2.2.4.3: Clinical medical radiation physics for imaging and radiation therapy

The SSC-16 report follows the format established by previous reports and begins with a general discussion of administrative items and collaborative ventures within the Agency. Selected projects are then discussed in turn. In general, the report mentions only those activities of the DMRP Section for which the SSC-16 has comments or recommendations at this time. It should be noted that when a particular service provided by the DMRP is not mentioned specifically, the SSC-16 strongly endorses its continuation and is particularly pleased to see the continuing support and involvement of the DMRP in appropriate TC projects. A list of acronyms is given in the Appendix.

3. Report

3.1 General Organizational Items

The SSC-16 was pleased to see that all twenty-three of the SSC-15 recommendations made in 2012 have been fully implemented or are in progress and nearly all of the comments made in the previous report have also been accepted. The quality and volume of work produced by the DMRP is impressive and the Deputy Director General, Mr Daud Mohamad, and the Director of the NAHU, Mr Rethy Chhem, are thanked sincerely for the support they give to the DMRP programme and budget.

The SSC-16 appreciated visiting the Dosimetry Laboratory (DOL) in Seibersdorf and indeed, during future SSC meetings would appreciate having more time

allocated to the DOL tour and discussion of DOL activities during the visit. Consequently, SSC-16 proposes that all the DOL presentations should be made at the DOL together with the laboratory visit.

The presentations to the SSC-16 were well made and much appreciated as were the printed copies of presentations, although two slides per page rather than four (printed back to back so as to have the same number of pages) would facilitate interpretation of some of the data.

The SSC-16 recognizes the importance of the DMRP's databases development that is merging several unique databases into a single relational database that includes:

a. DIRAC

b. Dosimetry Audit Network (DAN)

c. Calibrations and comparisons

d. Audits

e. Calibration and measurement capabilities (CMC) for Member States non-signatory to the Mutual Recognition Arrangement of the International Committee for Weights and Measures (CIPM MRA).

This new functional database will be a unique source of information for the IAEA, the WHO and the Member States. In addition to the information stored, this database encompasses numerous procedures and calculations that are mission-critical to the function of the DMRP in ensuring safe delivery of radiotherapy treatments to cancer patients in Member States. The maintenance and enhancement of the DMRP's database requires that the DMRP have full-time access to an IT specialist knowledgeable in the DMRP's computing activities and database requirements.

[R1] The SSC-16 recommends that a full-time IT staff position be retained for the maintenance and enhancement of the DMRP's database and, because it is crucial that the person appointed to this position understands the work processes of the DMRP, the SSC-16 recommends that the person is effectively a member of the Division of Human Health.

The SSC-16 proposes that the DMRP database continues to be enhanced and expanded to increase its functionality and accessibility to critical data. The SSC-16 is pleased to see that data for the DAN is being integrated and encourages the DMRP to keep this up to date so that it can be used for the recognition of Dosimetry Audit Networks.

The SSC-16 is honoured to assist in the evaluation of the DMRP's work for NAHU and the SSDL network, and was pleased to learn that its report will be perceived as useful in planning for the Agency programme and budget for 2016 to 2017 and future programmes.

3.2 Project 2.2.4.1 Calibration and Auditing Service

This project covers the dosimetry audit services and dosimetry calibration services including related development and activities. The audit services are considered to be very important by the SSC-16, for example, the IAEA/WHO TLD audit programme helps hospitals in the Member States, either directly or through national audit networks, to have confidence in the doses they are delivering to their patients.

Facilities

The SSC-16 is very pleased to see that there is a ReNuAL project to renovate and upgrade the laboratories at Seibersdorf and that the DMRP's Dosimetry Laboratory is included in the planning.

[R2] As a part of the ReNuAL programme, the SSC-16 recommends that:

a. the DMRP starts planning for the addition of a linear accelerator and develops a work plan with appropriate staffing for implementing and providing high energy x-ray calibration services and training once the DMRP linear accelerator is acquired and commissioned;

b. the DMRP starts planning for 192Ir and 60Co high-dose-rate (HDR) dosimetry;

c. the opportunity is taken to recycle the NSRW AmBe neutron source.

At the same time, the SSC-16 encourages the DMRP, the Division and other partners to assess the long-term plans for using the gamma camera facility and whether there would be an advantage in upgrading, noting that dual modality single-photon emission computed tomography (SPECT) together with X ray computed tomography (CT), known as (SPECT/CT) is the most appropriate tool for patient specific dosimetry.

The DOL is in the process of converting from using thermoluminescence dosimeters (TLD) to radio-photoluminescence (RPL) glass dosimeters. This change is necessitated by the age of the TLD readers, a technology that has been phased out by the manufacturer. In addition, the glass dosimetry system should be more efficient in terms of workflow and staffing needs.

[R3] The SSC-16 recommends that the DOL implements the glass dosimetry system as soon as possible, dependent on the readiness of the required database and full commissioning of the RPL glass dosimetry system.

The SSC-16 suggests that the DMRP adapts the related irradiation/data form(s) for postal dose audits to enable the data to be downloaded directly to the DMRP database for analysis and report generation.

The DMRP calibration services operate under a quality management system (QMS) that meets the requirements of ISO 17025. The last review of the DMRP QMS was carried out in 2012 by the EURAMET Regional Metrology Organization (RMO), which was proposed by the Joint Committee of the RMOs and the BIPM set up under the CIPM MRA (JCRB). Because of the international role of the DMRP, the SSC-16 believes that transparency and independence would be better served if QMS reviews were not always carried out by the same RMO.

[R21] The SSC-16 recommends that the DMRP make a request to the JCRB that no more than two consecutive major reviews (8-year cycle) of the DMRP QMS be carried out by the same RMO.

Calibrations and Comparisons

The number of requests for calibrations continues to increase as new national calibration laboratories are established (6 in the last biennium) and others are upgraded (16 in the last biennium) through national TC projects. Regional training courses and on-site expert missions have been particularly beneficial in improving dosimetry locally. The SSC-16 applauds the DMRP's efforts in supporting the SSDLs in low- and medium-income (LMI) countries and encourages the establishment of SSDL training workshops/fellowships on a regular basis. The committee noted that the updated Charter for the IAEA/WHO SSDL Network would be published in 2014/2015 and felt this would help to highlight the benefits as well as the obligations of membership.

The DOL currently provides over 600 calibration coefficients per year, for ionization chambers of the IAEA/WHO SSDL Network, over half of which are for diagnostic beams.

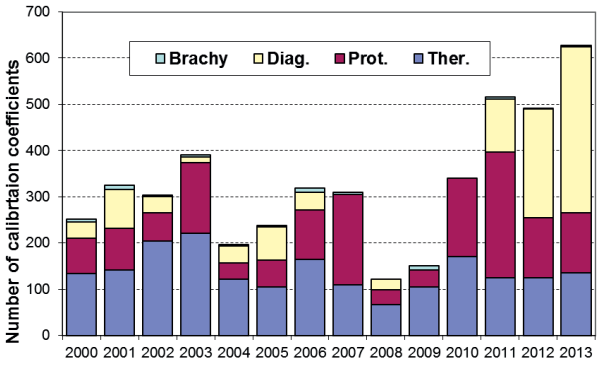

Figure 1 Distribution of IAEA calibration coefficients issued since 2000.

[R4] The SSC-16 recommends that, to respond to increasing demands for services from Member States, the DMRP make the following efficiency improvements:

a) the DOL should focus on the "chamber calibration coefficient" therapy level comparisons for SSDLs and reduce the number and frequency of TLD audits for SSDLs, particularly if chamber comparisons have been successful;

b) when calibrating ionization chambers for more than one beam quality the calibration coefficients should be for the chamber alone, when possible, and with one value per electrometer scale for the complete system at a single beam quality;

c) when recalibrating a chamber on a three-to-five year cycle, the number of calibration coefficients should be limited to not more than three appropriately selected X ray beam qualities unless justified.

The SSC-16 proposes that an article should be written for the SSDL Newsletter to explain the rationale for these latter two changes, and how traceability can be maintained with a reduced number of calibration points;

d) the DMRP should incorporate all calibration data automatically into the DMRP relational database.

The DMRP currently offers ionization chamber calibration coefficients for diagnostic imaging beam qualities, see Figure 1 (but see [R4] c above), and has taken part successfully in a computed tomography (CT) dosimetry comparison and a kerma-area-product (KAP) meter comparison. However, in view of the potentially high patient doses in CT, such dosimetry comparisons should take precedence over KAP meter comparisons.

[R5] The SSC-16 recommends that the DMRP provide a CT ionization chamber calibration service to SSDLs in the Network, in preference to a KAP meter calibration service.

The SSC-16 recognizes the importance of the DMRP's regular participation in RMO dosimetry comparisons to assure and extend traceability for measurements to the Member States. The SSC-16 is pleased to see the successful participation of the DMRP in the EURAMET RI(I)-S11 radiation protection level comparison and suggests that, if the RP level TLD audits show any discrepancies, a bilateral comparison using ionization chambers for the SSDL in question could assist in identifying the cause and also serve the SSDL concerned in assuring their calibration capabilities.

The SSC-16 proposes that the DMRP keeps a watching brief on the development of new dosimetry standards based on absorbed dose to water (Dw) for kV X rays and brachytherapy whilst maintaining the existing air kerma (NK) calibrations provided by the DOL.

Audits

The SSC-16 was pleased to note that 99 % of the SSDL results in radiotherapy beams were within the 3.5 % acceptance limit and that the one deviation was corrected through follow-up. However, this situation is not reflected

in the postal dose audits of radiotherapy centres, although the results have improved year-on-year, see Figure 2. This improvement may be due in part to the increased use of absorbed dose to water calibration protocols.

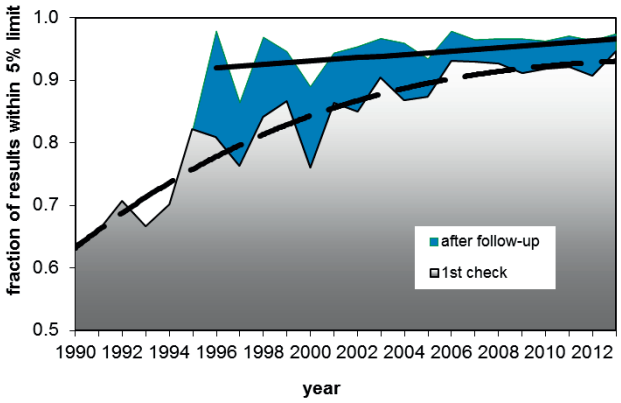

Figure 2 Fraction of the TLD results within the 5 % acceptance limit for radiotherapy centres. The lighter shaded area indicates the results obtained in the first check, and the blue area corresponds to the percentage of results improved in the follow-up process.

In view of the importance of correct radiotherapy dose delivery to patients to ensure safe and effective treatment, the SSC-16 encourages the DMRP in collaboration with the WHO to investigate, at the competent authority level in Member States, the 5 % of TLD-audited radiotherapy centre results (presently about 64) that have persistent dosimetry problems outside the acceptable ± 5 % dose range.

It was noted that 17 % of the recent deviations outside the acceptance level were due to set-up errors. The SSC-16 proposes that a video on the correct method to set-up the TLD audit system for irradiation by the institutions be developed and placed on the DOL's Human Health Campus website. The TLD irradiation instruction forms could be modified to indicate the URL for access to the video.

The SSC-16 was particularly pleased to note that radiotherapy centres are offered an immediate audit after beam commissioning of new installations and before patient treatments are started. However, the committee was concerned to learn from the outcome of the dosimetry audits networks (DAN) survey that approximately one-third of radiotherapy centres operate without any audit of their beam dosimetry. The committee also noted the outcome of the treatment planning system (TPS) audit conducted in Europe with IAEA support and was surprised that 11 of the 16 centres using the same clinical accelerator type had measurement points that significantly exceeded the agreed limits, but that subsequently several dosimetry and TPS related problems were identified and resolved.

The SSC-16 was pleased to see that the pilot study on dosimetry audits of high-energy electron beams has been completed and that the DMRP is now able to undertake electron dosimetry audits if requested. However, the SSC-16 is concerned that the potential workload could be overwhelming if this service is announced.

[R20] The SSC-16 recommends that the DMRP develop a work plan for implementing and providing an electron beam dosimetry audit service on a more routine basis, beyond just in response to specific requests, if the efficiency improvements (notably from recommendations R3 and R4) release sufficient manpower.

The SSC-16 is pleased to see the success of the regional training courses on QUATRO methodology with the support of TC and presumes that these will meet the needs of Member States. Noting that there have been 72 QUATRO missions to date, the SSC-16 applauds the DMRP's and Agency's efforts in supporting the QUATRO, QUAADRIL and QUANUM missions.

[R6] The SSC-16 recommends that these efforts continue, particularly by developing additional tools (e.g. a quality management system (QMS) template) to update QUAADRIL, and promoting its use.

3.3 Project 2.2.4.2 Developments in Radiation Dosimetry

This project focuses on research and development activities in radiation dosimetry, including the development and updates of dosimetry Codes of Practice (CoP).

It is noteworthy that an increasing number of radiotherapy centres are now using absorbed dose to water protocols, largely due to the widespread and free distribution of the IAEA publications. The dosimetry protocol TRS 398 is widely used as the basis of reference dosimetry in the Member States but has not been updated in the last decade.

[R8] The SSC-16 recommends that the update of TRS 398 should go ahead without delay, noting that the addendum to the TG-51 report produced by the American Association of Physicists in Medicine (AAPM) had already been published and includes many more chambers and new kQ values. The SSC-16 is pleased to note that the DMRP is considering a common database with the AAPM for chamber kQ values.

The SSC-16 noted with great interest the continued work towards the development of the small field dosimetry CoP and looks forward to its publication.

[R17] Subsequent to the (future) publication of the protocol for small field dosimetry, the SSC-16 recommends that a CRP be organized with a pilot

dosimetry audit to support implementation of the new protocol (CoP).

The SSC-16 reviewed the results of a survey regarding a possible brachytherapy dosimetry CoP and noted that Member States are receiving TC support for the introduction of brachytherapy equipment.

[R7] In view of the increasing use by Member States of ^{60}Co for brachytherapy, the SSC-16 recommends that a CoP for brachytherapy dosimetry, including ^{60}Co sources, be developed and published.

[R13] Now that the use of 90Y therapy is worldwide, the SSC-16 recommends that the DMRP, in collaboration with NMDI and ARBR, investigate and gather information on the need to develop guidelines on the use and dosimetry of 90Y microspheres.

It is recognized internationally that radionuclide therapy requires a higher level of quantification and traceability than diagnostic nuclear medicine. The first step to reliable dosimetry for therapeutic nuclear medicine is quantitative imaging, which relies on activity (dose) calibrator traceability as a prerequisite.

[R14] The SSC-16 recommends a renewed effort to establish mechanisms that will enable dose calibrator traceability in support of nuclear medicine dosimetry. The DMRP should evaluate the possibility of supporting this functionality through the SSDL Network.

The SSC-16 suggests that the DMRP establish contact with the Metrology for molecular radiation therapy (MetroMRT) effort being led by National Physical Laboratory (NPL), UK under the European Commission's metrology projects programme (http://projects.npl.co.uk/metromrt/) to develop traceability and improve quantification in nuclear medicine dosimetry. The grant ends 1 June 2015 and the DMRP could investigate how much of the outcome could be adopted in 2016/17.

The SSC-16 is aware of the urgent need for uniformity in approach for the estimation of patient doses in diagnostic imaging to enable the justification and optimization processes to be undertaken appropriately in medical radiation use.

[R19] In view of the many different patient dose estimation methods in use, the SSC-16 recommends that the DMRP (in collaboration with NSRW) investigate and gather information on the need to develop guidelines on patient dose estimation in diagnostic imaging.

Priority should perhaps be given to collecting dosimetry data on paediatrics in nuclear medicine. This could highlight the need to optimize the activity administered depending on the child's overall characteristics, not just the weight.

[R18] To match available tools for calculating fetal doses in diagnostic radiology, the SSC-16 recommends that the DMRP develop a tool for patient dosimetry in nuclear medicine (with NSRW) for a rapid evaluation of the dose to a fetus following nuclear medicine radionuclide intake by the mother.

3.4 Project 2.2.4.3 Clinical Medical Radiation Physics

This project aims at developing guidelines and training material for best practice in clinical medical radiation physics. It also promotes comprehensive audits and research in the clinical environment through CRPs. The project includes diagnostic radiology and nuclear medicine imaging physics as well as radiotherapy physics.

The DMRP is currently considering the production of guidelines on QA for SPECT/CT systems. When producing the standard operating procedures for SPECT/CT, the SSC-16 suggests that the DMRP and NMDI should take account of other efforts in a similar vein e.g. the Committee on medical internal radiation dose (MIRD) publications and the European Association for Nuclear Medicine (EANM) dosimetry group guidelines.

The SSC-16 is pleased to see the imminent publication of the Diagnostic Radiology Physics Handbook with the availability of its slides for teaching purposes, and also the Nuclear Medicine Physics Handbook scheduled for 2014. The slides to support this latter publication will be very much welcomed. In many developing countries the IAEA publications are the major source of information for medical physicists.

The ongoing Agency project on how to set up an imaging department could include information on options currently available, depending on the type and quantity of equipment, for medical physicist participation in an imaging service (such as external consulting).

A number of remote radiology sites have the capability to transmit images to radiologists at major centres for their expert diagnosis.

[R9] The SSC-16 recommends that the DMRP help establish a similar capability for remote (or automated) quality control evaluation by developing appropriate methodologies. The SSC-16 proposes that the DMRP establish a CRP to assess and develop a remote audit of diagnostic imaging to assess imaging quality.

[R12] In view of the increasing use of digital radiology in all Member States, and considering the publication of "Worldwide Implementation of Digital Imaging in Radiology", the SSC-16 recommends that the DMRP develop medical physics oriented guidelines for LMI

countries on how to effect the transition from conventional to digital imaging.

[R23] In view of the considerable advances in tomographic techniques and the possibility of updating current DMRP guidelines regarding quality control and recommended imaging techniques, the SSC-16 recommends that the DMRP explore the possibility and benefits of initiating a CRP on the use and quality assurance of novel tomographic imaging techniques that are being adopted by Member States.

The SSC-16 is pleased to see that the DMRP keeps a watching brief on the developments in advanced imaging modalities so that guidelines can be produced when necessary.

The SSC-16 encourages the DMRP, the Division and other partners to assess the long-term plans for using the Seibersdorf gamma camera facility and whether there would be an advantage in upgrading, noting that dual modality SPECT/CT is the most appropriate tool for patient specific dosimetry. Future CRPs involving nuclear medicine protocols should include the Seibersdorf gamma camera laboratory as one of the sites participating in the protocol, whenever practicable. Similarly the SSC-16 supports the use of the gamma camera facility to generate on-line guidance videos (for example for quality control activities) and to place these on the Human Health Campus to assist Member States.

The dosimetry methodologies required for therapeutic nuclear medicine differ from the methods that have been developed for diagnostic nuclear medicine imaging applications.

[R22] The SSC-16 recommends that the DMRP review and assess the adequacy of existing training material on the fundamentals of dosimetry for the therapeutic use of radionuclides and, if necessary, develop appropriate training material specifically for the dosimetry of therapeutic nuclear medicine.

[R10] The SSC-16 applauds the DMRP's efforts in supporting doctoral CRPs and recommends that the present CRP on quantitative imaging in nuclear medicine is complemented by a new doctoral CRP to support the dosimetry of nuclear medicine therapy.

[R16] In view of the potential use of alpha particle therapy by Member States, the SSC-16 recommends that the DMRP assess the need to develop guidelines on targeted therapy with alpha emitters (together with NMDI, NAPC, NSRW) and liaise with the NSRW on the opportunity to develop guidance for regulators regarding health and safety issues related to the use of alpha particles specifically for therapy of patients.

The SSC-16 encourages the collaboration with the ARBR regarding the radiobiology of radionuclide therapy, alpha-emitters and heavy-particle beams. Such a collaboration would help DMRP develop guidelines that incorporate radiobiological quantities that relate absorbed dose to biological outcome. Note should be taken of ongoing work by the ICRU on bio-effect modelling and equi-effective dose concepts in radiation therapy.

[R11] In view of the increasing use and importance of patient image-based radiotherapy delivery, the SSC-16 recommends that guidelines be developed for acceptance testing, commissioning and routine QA for imaging in radiotherapy, including on-board imaging (OBI) devices.

[R15] With the need to keep Member States up to date with new technological developments in radiotherapy, the SSC-16 recommends that guidelines for implementation and QA be developed for flattening filter free (FFF) radiotherapy beams.

The SSC-16 noted that several manufacturers are proposing to combine a magnetic resonance imaging (MRI) system for in situ imaging with a radiation beam. This may have consequences for the response of some dosimetry equipment that should be investigated.

[R24] Now that MRI machines are being combined with radiotherapy systems and the number of proton therapy centres worldwide has increased, the SSC-16 recommends that the DMRP investigate and gather information on the need to develop guidelines for dosimetry and QA for radiotherapy/MRI and proton therapy modalities, and consider including relevant aspects in the revision of the 2005 document on setting up a radiotherapy centre.

The SSC-16 notes the work undertaken within the present CRP on the methodology for remote audits for advanced treatment techniques including small beams relevant to stereotactic radiosurgery (SRS) and IMRT treatment modalities, and proposes that the audit methodology is disseminated as soon as practicable.

Failure Mode and Effects Analysis (FMEA) is a systematic approach to failure analysis and it may be a useful approach for radiotherapy dosimetry QA.

[R25] The SSC-16 recommends that the DMRP, in collaboration with NSRW, investigate and gather information on the need to develop FMEA guidelines for radiotherapy dosimetry QA, taking into account the existing experience.

Documents recently published or in preparation emphasize the need for uncertainty estimation throughout the radiotherapy chain, as endorsed by the ICRU and professional societies. The SSC-16 supports the inclusion of dose uncertainty estimation in training courses, run in collaboration with Division partners, for medical physicists, radiation oncologists and radiation therapy technologists.

The SSC-16 congratulates the DMRP for the considerable support given to the DIRAC project that provides all

Member States with up-to-date information on radiotherapy resources. The WHO noted that it has used DIRAC information to complement Ministry of Health information on availability of radiation technology per country in the World Health Statistics, published yearly for the World Health Assembly.

4. SSC-16 Recommendations (sorted by priority order)

Recommendations

High Priority

[R1] The SSC-16 recommends that a full-time IT staff position be retained for the maintenance and enhancement of the DMRP's database and, because it is crucial that the person appointed to this position understands the work processes of the DMRP, the SSC-16 recommends that the person is effectively a member of the Division of Human Health.

[R2] As a part of the ReNuAL programme, the SSC-16 recommends that:

a) the DMRP starts planning for the addition of a linear accelerator and develops a work plan with appropriate staffing for implementing and providing high energy x-ray calibration services and training once the DMRP linear accelerator is acquired and commissioned;

b) the DMRP starts planning for 192Ir and 60Co high-dose-rate (HDR) dosimetry; the opportunity is taken to recycle the NSRW AmBe neutron source.

[R3] The SSC-16 recommends that the DOL implements the glass dosimetry system as soon as possible, dependent on the readiness of the required database and full commissioning of the RPL glass dosimetry system.

[R4] The SSC-16 recommends that, to respond to increasing demands for services from Member States, the DMRP make the following efficiency improvements:

a) the DOL should focus on the "chamber calibration coefficient" therapy level comparisons for SSDLs and reduce the number and frequency of TLD audits for SSDLs, particularly if chamber comparisons have been successful;

b) when calibrating ionization chambers for more than one beam quality the calibration coefficients should be for the chamber alone, when possible, and with one value per electrometer scale for the complete system at a single beam quality;

c) when recalibrating a chamber on a three-to-five year cycle, the number of calibration coefficients should be limited to not more than three appropriately selected X ray beam qualities unless justified.

The SSC-16 proposes that an article should be written for the SSDL Newsletter to explain the rationale for these latter two changes, and how traceability can be maintained with a reduced number of calibration points;

d) The DMRP should incorporate all calibration data automatically into the DMRP relational database.

[R5] The SSC-16 recommends that the DMRP provide a CT ionization chamber calibration service to SSDLs in the Network, in preference to a KAP meter calibration service.

[R6] Noting that there have been 72 QUATRO missions to date, the SSC-16 applauds the DMRP's and Agency's efforts in supporting the QUATRO, QUAADRIL and QUANUM missions. The SSC-16 recommends that these efforts continue, particularly by developing additional tools (e.g. a quality management system (QMS) template) to update QUAADRIL, and promoting its use.

[R7] In view of the increasing use by Member States of 60Co for brachytherapy, the SSC-16 recommends that a CoP for brachytherapy dosimetry, including 60Co sources, be developed and published.

[R8] The SSC-16 recommends that the update of TRS 398 should go ahead without delay, noting that the addendum to the TG-51 report produced by the American Association of Physicists in Medicine (AAPM) had already been published and includes many more chambers and new kQ values. The SSC-16 is pleased to note that the DMRP is considering a common database with the AAPM for chamber kQ values.

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[R10] The SSC-16 applauds the DMRP's efforts in supporting doctoral CRPs and recommends that the present CRP on quantitative imaging in nuclear medicine is complemented by a new doctoral CRP to support the dosimetry of nuclear medicine therapy.

[R11] In view of the increasing use and importance of patient image-based radiotherapy delivery, the SSC-16 recommends that guidelines be developed for acceptance testing, commissioning and routine QA for imaging in radiotherapy, including on-board imaging (OBI) devices.

[R12] In view of the increasing use of digital radiology in all Member States, and following the publication of "Worldwide Implementation of Digital Imaging in Radiology", the SSC-16 recommends that the DMRP develop medical physics oriented guidelines for LMI countries on how to effect the transition from conventional to digital imaging.

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[R14] The SSC-16 recommends a renewed effort to establish mechanisms that will enable dose calibrator traceability in support of nuclear medicine dosimetry. The DMRP should evaluate the possibility of supporting this functionality through the SSDL Network.

Medium Priority

[R15] With the need to keep Member States up to date with new technological developments in radiotherapy, the SSC-16 recommends that guidelines for implementation and QA be developed for flattening filter free (FFF) radiotherapy beams.

[R16] In view of the potential use of alpha particle therapy by Member States, the SSC-16 recommends that the DMRP assess the need to develop guidelines on targeted therapy with alpha emitters (together with NMDI, NAPC, NSRW) and liaise with the NSRW on the opportunity to develop guidance for regulators regarding health and safety issues related to the use of alpha particles specifically for therapy of patients.

[R17] Subsequent to the (future) publication of the protocol for small field dosimetry, the SSC-16 recommends that a CRP be organized with a pilot dosimetry audit to support implementation of the new protocol (CoP).

[R18] To match available tools for calculating fetal doses in diagnostic radiology, the SSC-16 recommends that the DMRP develop a tool for patient dosimetry in nuclear medicine (with NSRW) for a rapid evaluation of the dose to a fetus following nuclear medicine radionuclide intake by the mother.

[R19] In view of the many different patient dose estimation methods in use, the SSC-16 recommends that the DMRP (in collaboration with NSRW) investigate and gather information on the need to develop guidelines on patient dose estimation in diagnostic imaging.

[R20] The SSC-16 recommends that the DMRP develop a work plan for implementing and providing an electron beam dosimetry audit service on a more routine basis, beyond just in response to specific requests, if the efficiency improvements (notably from recommendations R3 and R4) release sufficient manpower.

[R21] The SSC-16 recommends that the DMRP make a request to the JCRB that no more than two consecutive major reviews (8-year cycle) of the DMRP QMS be carried out by the same RMO.

[R22] The SSC-16 recommends that the DMRP review and assess the adequacy of existing training material on the fundamentals of dosimetry for the therapeutic use of radionuclides and, if necessary, develop appropriate training material specifically for the dosimetry of therapeutic nuclear medicine.

[R23] In view of the considerable advances in tomographic techniques and the possibility of updating current DMRP guidelines regarding quality control and recommended imaging techniques, the SSC-16 recommends that the DMRP explore the possibility and benefits of initiating a CRP on the use and quality assurance of novel tomographic imaging techniques that are being adopted by Member States.

Low Priority

[R24] Now that MRI machines are being combined with radiotherapy systems and the number of proton therapy centres worldwide has increased, the SSC-16 recommends that the DMRP investigate and gather information on the need to develop guidelines for dosimetry and QA for radiotherapy/MRI and proton therapy modalities, and consider including relevant aspects in the revision of the 2005 document on setting up a radiotherapy centre.

[R25] The SSC-16 recommends that the DMRP, in collaboration with NSRW, investigate and gather information on the need to develop FMEA guidelines for radiotherapy dosimetry QA, taking into account the existing experience.

5. SSC-16 Comments

5.1 General

• The SSC-16 appreciated visiting the Dosimetry Laboratory (DOL) in Seibersdorf and indeed, during future SSC meetings would appreciate having more time allocated to the DOL tour and discussion of DOL activities during the visit. Consequently, SSC-16 proposes that all the DOL presentations should be made at the DOL together with the laboratory visit. The presentations to the SSC-16 were well made and much appreciated as were the printed copies of presentations, although two slides per page rather than four (printed back to back so as to have the same number of pages) would facilitate interpretation of some of the data.

• The SSC-16 proposes that the DMRP database continues to be enhanced and expanded to increase its functionality and accessibility to critical data. The SSC-16 is pleased to see that data for the DAN is being integrated and encourages the DMRP to keep this up to date so that it can be used for the recognition of Dosimetry Audit Networks.

5.2 Project 2.2.4.1 Calibration and Auditing Service

• The SSC-16 proposes that the DMRP keeps a watching brief on the development of new dosimetry standards based on absorbed dose to water (Dw) for kV X rays and brachytherapy whilst maintaining the existing air kerma (N_K) calibrations provided by the DOL.

• In view of the importance of correct radiotherapy dose delivery to patients to ensure safe and effective treatment, the SSC-16 encourages the DMRP in collaboration with the WHO to investigate, at the competent authority level in Member States, the 5 % of TLD-audited radiotherapy centre results (presently about 64) that have persistent dosimetry problems outside the acceptable ± 5 % dose range.

• It was noted that 17 % of the recent deviations outside the acceptance level were due to set-up errors. The SSC-16 proposes that a video on the correct method to set-up the TLD audit system for irradiation by the institutions be developed and placed on the DOL's Human Health Campus website. The TLD irradiation instruction forms could be modified to indicate the URL for access to the video.

• The SSC-16 applauds the DMRP's efforts in supporting the SSDLs in low- and medium-income (LMI) countries and encourages the establishment of SSDL training workshops/fellowships on a regular basis.

• The SSC-16 recognizes the importance of the DMRP's regular participation in RMO dosimetry comparisons to assure and extend traceability for measurements to the Member States.

• The SSC-16 is pleased to see the successful participation of the DMRP in the EURAMET RI(I)-S11 radiation protection level comparison and suggests that, if the RP level TLD audits show any discrepancies, a bilateral comparison using ionization chambers for the SSDL in question could assist in identifying the cause and also serve the SSDL concerned in assuring their calibration capabilities.

5.3 Project 2.2.4.2 Developments in Radiation Dosimetry

• The SSC-16 suggests that the DMRP establish contact with the Metrology for molecular radiation therapy (MetroMRT) effort being led by National Physical Laboratory (NPL), UK under the European Commission's metrology projects programme (http://projects.npl.co.uk/metromrt/) to develop traceability and improve quantification in nuclear medicine dosimetry. The grant ends 1 June 2015 and the DMRP could investigate how much of the outcome could be adopted in 2016/17.

• The SSC-16 is pleased to see the success of the regional training courses on QUATRO methodology with the support of TC and presumes that these will meet the needs of Member States.

5.4 Project 2.2.4.3 Clinical Medical Radiation Physics

• The SSC-16 notes the present CRP on the methodology for remote audits for advanced radiotherapy techniques including small beams relevant to stereotactic radiosurgery (SRS) and IMRT treatment modalities and proposes that the audit methodology is disseminated as soon as practicable.

• When producing the standard operating procedures for SPECT/CT, the SSC-16 suggests that the DMRP and NMDI should take account of other efforts in a similar vein e.g. the Committee on medical internal radiation dose (MIRD) publications and the European Association for Nuclear Medicine (EANM) dosimetry group guidelines.

• The SSC-16 encourages the collaboration with the ARBR regarding the radiobiology of radionuclide therapy, alpha-emitters and heavy-particle beams. Such collaboration would help DMRP develop guidelines that incorporate radiobiological quantities that relate absorbed dose to biological outcome. Note should be taken of ongoing work by the ICRU on bio-effect modelling and equi-effective dose concepts in radiation therapy.

• The SSC-16 encourages the DMRP, the Division and other partners to assess the long-term plans for using the Seibersdorf gamma camera facility and whether there would be an advantage in upgrading, noting that dual modality SPECT/CT is the most appropriate tool for patient specific dosimetry. Future CRPs involving nuclear medicine protocols should include the Seibersdorf gamma camera laboratory as one of the sites participating in the protocol, whenever practicable. Similarly the SSC-16 supports the use of the gamma camera facility to generate on-line guidance videos (for example for quality control activities) and to place these on the Human Health Campus to assist Member States.

• The SSC-16 is pleased to see the imminent publication of the Diagnostic Radiology Physics Handbook with the availability of its slides for teaching purposes, and also the Nuclear Medicine Physics

Handbook scheduled for 2014. The slides to support this latter publication will be very much welcomed. In many developing countries the IAEA publications are the major source of information for medical physicists.

- The ongoing project on how to set up an imaging department could include information on options currently available, depending on the type and quantity of equipment, for medical physicist participation in an imaging service (such as external consulting).
- Documents recently published or in preparation emphasize the need for uncertainty estimation throughout the radiotherapy chain, as endorsed by the ICRU and professional societies. The SSC-16 supports the inclusion of dose uncertainty estimation in training courses, run in collaboration with Division partners, for medical physicists, radiation oncologists and radiation therapy technologists.
- The SSC-16 is pleased to see that the DMRP keeps a watching brief on the developments in advanced imaging modalities so that guidelines can be produced when necessary.

SSC-16 members during their visit of IAEA Dosimetry Laboratory, Seibersdorf, Mar 2014

Acronyms used in the SSC-16 Report

3-D	3-dimensional
AMRO-PAHO	American Regional Office - Panamerican Health Organization
ARBR	Applied Radiation Biology and Radiotherapy Section of the Agency
BIPM	Bureau International des Poids et Mesures
BSS	Basic Safety Standards (refers to « International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources », Agency publication No. 115 in the Safety Series)
CIPM	International Committee of Weights and Measures (BIPM)
CMC	Calibration and Measurement Capability
CoP	Code of Practice
CRP	Coordinated Research Project of the Agency
CT	Computed tomography
DG	Director General (of the Agency)
DIRAC	Directory of Radiotherapy Centres
DMRP	Dosimetry and Medical Radiation Physics Section of the Agency
DOL	Agency's Dosimetry Laboratory
ESTRO	European Society for Therapeutic Radiology and Oncology
EURAMET	European Collaboration in Measurement Standards
FMEA	Failure Mode and Effects Analysis
HDR	High dose rate
IAEA	International Atomic Energy Agency
ICRU	International Commission on Radiation Units and Measurements
IDAS	International Dose Assurance Service
IGRT	Image-guided radiation therapy
IMRT	Intensity modulated radiation therapy
IOMP	International Organization for Medical Physics
ISO	International Organization for Standardization
JCRB	Joint Committee of Regional Metrology Organizations and the BIPM
KAP	Kerma-area-product
LMI	Low and middle-income countries
MRA	Mutual Recognition Arrangement of the CIPM (CIPM MRA)
MRI	Magnetic resonance imaging
NAAL	Agency's Laboratories Division, Vienna and Seibersdorf
NAHU	Division of Human Health of the Agency
NMS	Nuclear Medicine Sub-programme
NPL	National Physical Laboratory, UK
PACT	Programme of Action for Cancer Therapy of the Agency
PAHO	Pan-American Health Organization, the Regional Office of the WHO
PET/CT	Positron Emission Tomography/Computed Tomography
QA	Quality assurance
QUADDRIL	Quality assurance audit for diagnostic radiology improvement and learning
QUANUM	Quality assurance in nuclear medicine
QMS	Quality management system

QS	Quality system
QUATRO	Quality Assurance Team for Radiation Oncology
RMO	Regional Metrology Organization
RP	Radiation protection
SPECT	Single photon emission computed tomography
SSC	SSDL Scientific Committee
SSDL	Secondary Standards Dosimetry Laboratory
TC	Department of Technical Cooperation of the Agency
TL	Thermoluminescent, or thermoluminescence
TLD	Thermoluminescent dosimeter, or thermoluminescence dosimetry
TPS	Treatment Planning System
TRS	Technical Reports Series (an Agency publication series)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
URL	Uniform Resource Locator for the internet address
WHO	World Health Organization

Development of a Training Programme for Secondary Standards Dosimetry Laboratories

Report of a Consultants Meeting, IAEA, Vienna, 19-23 May 2014

Consultants: Mehenna Arib (ALG), Teogenes Augusto Da Silva (BRA), Ralf-Peter Kapsch (GER), Konstatinos Hourdakis (GRE)

IAEA staff: Ahmed Meghzifene (Section Head, DMRP), Karen Christaki (Medical Physicist, DMRP), Istvan Csete and Ladislav Czap (Senior Laboratory Technicians, Dosimetry Laboratory in Seibersdorf, DMRP) and Igor Gomola (SSDL Officer and Scientific Secretary of the meeting, DMRP)

In 1976, the International Atomic Energy Agency (IAEA) together with the World Health Organization (WHO) established a Network of Secondary Standard Dosimetry Laboratories (SSDLs), known as the IAEA/WHO SSDL network. This network, through SSDLs designated by Member States, provides the link between users and primary standards, mainly for countries that are not members of Metre Convention. The network presently consists of 84 laboratories in 67 Member States, of which more than half are developing countries. The main function of an SSDL is to provide calibration services, including the dissemination of information on calibration procedures, and practical help to users on instruments used in their particular application. Some SSDLs having appropriate facilities and expertise to provide additional services, such as: (i) Dosimetry comparisons for medical institutions at national or regional level (using TLD, ion chambers or on-site visits) (ii) Reference irradiations for personal radiation dosimeter services (iii) Advise users on quality assurance matters (iv) Training courses in radiation measurement and calibration techniques and use and maintenance of the instrumentation.

The SSDLs shall have managerial and technical personnel who have, qualifications and competence to operate the specific equipment needed for radiation measurements, perform calibrations, evaluate the results and authorize

Participants of the Consultants Meeting on Development of a Training Programme for SSDLs, Vienna, May 2014

calibration certificates complying with the standard ISO/IEC 17025:2005. Staff working at SSDLs should possess adequate qualifications and experience in radiation dosimetry and laboratory measurement procedures appropriate to their level of responsibilities.

In order to provide guidance on training requirements and ensure harmonization of training programmes, it was decided to prepare a comprehensive training material for SSDL staff. Member States are expected to use the training material developed by the Agency to ensure adequate level of qualification of SSDL staff. The Agency will also make use of the harmonized training programme to ensure consistency in the training of fellows at the IAEA Dosimetry Laboratory in Seibersdorf and at other advanced SSDLs of the IAEA/WHO Network.

There was one consultant's meeting on preparation of a Training programme for the Secondary Standards Dosimetry Laboratory Staff held at the IAEA, 7-11 November 2005. A draft that includes outline of (i) background in radiation dosimetry, (ii) traceability and measurement standards, (iii) calibration procedures and equipment at SSDLs, (iv) uncertainty of measurement and reporting results, and (v) comparison programmes for SSDLs was prepared. The draft focused on the training programme mainly applicable to SSDLs providing calibration services in radiation therapy.

From 19 to 23 May 2014 a consultants' meeting was held at the IAEA Headquarters with the purpose to develop a comprehensive training programme for SSDLs.

The last version of the draft which included five sections and four appendices was reviewed and a new title "Training on radiation metrology: A handbook for SSDLs" and structure were proposed.
The new version of the training material covers the dosimetry calibrations at therapy, diagnostic and protection level, including brachytherapy and calibration of surface contamination meters. The new structure includes the following chapters: 1) Introduction, 2) Role of SSDLs, 3) Overview of IAEA training programmes for SSDLs,
4) Requirements, Tasks and Evaluation of the training, 5) Physics background, 6) Primary and secondary standards, 7) Safety and security requirements, 8) Dosimetry protocols, 9) Equipment, Devices and Facilities, 10) Calibration procedures, 11) Calibration workflow, 12) Quality assurance and quality control procedures, 13) Comparisons and audits, 14) Estimation of uncertainties, 15) Reporting of results, 16) Establishment of QMS, 17) Cooperation with end-users, 18) IAEA Scientific visits, 19) IAEA Fellowships, 20) IAEA Training Courses, 21) Academic programmes for radiation metrology. The appendices will contain tables, reference data and typical specifications of equipment used at SSDLs. The draft of the document will be sent to the SSDL Network Members in order to seek their feedback. The comments received from the SSDLs will be consolidated and implemented into the final version of the document.

A new IAEA/RCA Regional Project in Medical Physics Education and Training: RAS/6/077

Report of a technical meeting of the project, IAEA, Vienna, 14-16 May 2014

Participants at RCA6077 Technical Meeting, Vienna, May 2014

The International Atomic Energy Agency IAEA (http://www.iaea.org/) and the Regional Cooperative Agreement RCA (http://www.rcaro.org/) have a long history in supporting development projects in the Asian region in radiation medicine. A previous project RAS/6/038 which began in 2003 helped to formalise the clinical training of medical physicists in radiation medicine through piloting clinical training programs in various countries and developing standards for training in the medical physics of radiotherapy, diagnostic radiology and nuclear medicine (IAEA Training Course Series 37, 47 and 50). In recognition of the important role of clinical medical physicists in the safety and quality of radiation medicine, the IAEA and RCA has decided to support a new project in medical physics education and training beginning in 2014, namely RAS/6/077 "Strengthening the Effectiveness and Extent of Medical Physics Education and Training". This new four-year project intends to build on the success of the previous project RAS/6/038 in expanding the base of formal clinical training programs for medical physicists and providing support and training materials to new and established clinical training programs. All 20 RCA member countries are open to participate in the project (please browse the RCA website for a list of the member countries). Relatively new members to the RCA include Nepal and Palau. The lead country coordinator (LCC) for the project is Dr Donald McLean (Donald.McLean@act.gov.au), the technical officer supporting the project at the IAEA is Mr Brendan Healy (B.Healy@iaea.org) and the programme management officer for the project responsible for the management of the project at the IAEA is Ms Mawieh Oulabi (M.Oulabi@iaea.org).

The IAEA and RCA recognise the problem that unless sufficient numbers of new medical physics are trained in radiation medicine, there will be a shortage of medical physicists in the future. As the spread of radiation medicine increases (think of the wide availability now and likely in the future of PET-CT scanners and advanced medical linear accelerators and the increasing application of CT scanning in diagnosis and treatment) then the need for clinically qualified medical physicists grows. It is hoped that the new project RAS/6/077 can play some part in identifying precisely what the need is for medical physics services in the Asian region, in defining exactly what medical physicists do in the context of the Asian region, in promoting the recognition of the medical physics profession to governments, and in supporting clinical training programs now so that the new generation of medical physicists is comprehensively trained as they enter workforce. The first technical meeting of the project was

held in Vienna in May 2014 with representatives attending from 15 RCA member states. Some the results achieved from the meeting were a plan for incorporation of e-learning and remote supervision in medical physics clinical training programs, adoption of survey forms for gathering information of the current status of medical physics workforce and education and training in RCA member states, agreement on a platform for e-learning, and requests for piloting of future clinical training programs which include e-learning in 2015.

Useful IAEA publications:

IAEA HHS 25, Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists, http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1610_web.pdf

IAEA TCS 37, Clinical Training of Medical Physicists Specializing in Radiation Oncology, http://www-pub.iaea.org/MTCD/publications/PDF/TCS-37_web.pdf

IAEA TCS 47, Clinical Training of Medical Physicists Specializing in Diagnostic Radiology, http://www-pub.iaea.org/MTCD/publications/PDF/TCS-47_web.pdf

IAEA TCS 50, Clinical Training of Medical Physicists Specializing in Nuclear Medicine, http://www-pub.iaea.org/MTCD/publications/PDF/TCS-50_web.pdf

IAEA TCS 56, Postgraduate Medical Physics Academic Programmes, http://www-pub.iaea.org/MTCD/Publications/PDF/IAEA-TCS-56_web.pdf

IAEA PUB 1196, Radiation Oncology Physics: A Handbook for Teachers and Students, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1196_web.pdf

Diagnostic Radiology Physics: A Handbook for Teachers and Students

One of the important activities of the International Atomic Energy Agency is the education of professionals responsible for the application of radiation. Within this framework, the IAEA has a long history of supporting medical physics education, both indirectly, through the publication of guidance documents, and directly through its Technical Cooperation programme, including the support of Member States in developing their own national postgraduate education programmes in medical physics, development of clinical training guides and, more recently, web based educational resources.

In 2005, the IAEA published "Radiation Oncology Physics: A Handbook for Teachers and Students", as a result of a process of harmonizing the syllabus for university education of medical physicists in radiation oncology. Following the success of this publication, it was apparent that a similar need existed in the other two specialities of medical physics, namely diagnostic radiology and nuclear medicine. Within this framework, the Diagnostic Radiology Physics: A Handbook for Teachers and Students was released in September 2014 (Fig 1). Within the first week of its online release, the Diagnostic Radiology Handbook had almost 3,500 page views, proving not only the need of the publication itself, but also that its wide dissemination by the IAEA will contribute to the harmonization of education in diagnostic radiology physics.

The "Diagnostic Radiology Physics: A Handbook for Teachers and Students" (http://www-pub.iaea.org/books/IAEABooks/8841/Diagnostic-Radiology-Physics-A-Handbook-for-Teachers-and-Students) is dedicated to students and teachers involved in programmes that train professionals who are expected to work in diagnostic radiology, guiding the reader through the essential physics of diagnostic radiology and its application in modern medicine. It is useful not only to medical physicists and to graduate students in medical physics programmes, but also to residents in diagnostic radiology and advanced students in radiographic technology programmes. It is important to highlight that the handbook is not designed to replace the large number of textbooks available on many aspects of diagnostic radiology physics, which are necessary to deepen knowledge in the specific topics. It is expected to successfully fill a gap in the teaching material for medical radiation physics in imaging, providing, in a single volume, the largest possible coverage of topics available today. The development of this handbook was ongoing for several years, since the combination of different expertise to cover the whole spectrum of the contents was a major undertaking. This has been achieved with the contributions of 41 authors and reviewers from 12 different countries.

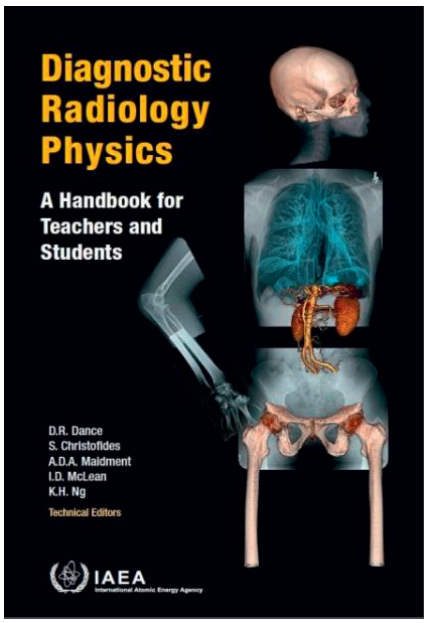

Fig. 1. Diagnostic Radiology Physics: A Handbook for teachers and Students

The 24 chapters include a broad coverage of topics relevant to diagnostic radiology physics, including radiation physics, dosimetry and instrumentation, image quality and image perception, imaging modality specific topics, recent advances in digital techniques, and radiation biology and protection.

Endorsement of this handbook has been granted by the American Association of Physicists in Medicine (AAPM), the Asia–Oceania Federation of organizations for Medical Physics (AFOMP) and the European Federation of Organisations for Medical Physics (EFOMP). Further promoting the educational role of the handbook, additional training material, in the form of PowerPoint presentations, has being developed and reviewed for each chapter of the handbook. They are designed, as an additional training tool to assist in the correct and comprehensive presentation of the content of each chapter. The slides are available through the IAEA Human Health Campus website (http://nucleus.iaea.org/HHW/Home/index.html) as PDF files; however, the corresponding PowerPoint files could be distributed to lecturers/trainers for adaptation, upon request to dosimetry@iaea.org.

Courses, Meetings and Consultancies in 2015

TC Courses and Workshops related to DMRP activities

Train the Trainers Workshop on Medical Physics Support for Nuclear or Radiological Emergencies, Fukushima, Japan, 22—26 June 2015

Joint ICTP-IAEA Workshop on Transitioning from 2-D Brachytherapy to 3-D High-Dose-Rate Brachytherapy, ICTP, Trieste, Italy, 16—20 November 2015

Training Course on Small Field Dosimetry, Argonne National Laboratory (ANL),Chicago, USA, 10—14 December 2015

DMRP Meetings and Consultancies

Consultants Meeting on "Preparation of the CRP on the Evaluation and Optimization of Pediatric Imaging", Vienna, Austria, 12—14 January 2015

Consultants Meeting to "Review the first draft of the chapters related to nuclear medicine medical physics of the Nuclear Medicine Resources Manual", Vienna, Austria, 16—18 March 2015

Consultancy Visit to "Advise the IAEA on Identifying Gaps in QA Guidelines for Advanced Techniques", Vienna, Austria, 16—20 March 2015

2nd RCM on the CRP on Advances in Medical Imaging Techniques, Vienna, Austria, 23—27 March 2015

Consultants Meeting to "Review the content and design of Diagnostic Imaging Medical Physics webpages of the Human Health Campus", Vienna, Austria, 20—24 April 2015

Consultants Meeting on "Review the draft of the document SPECT and SPECT/CT Atlas of quality controls and image artefacts", Vienna, Austria, 6—8 May 2015

Consultants' Meeting to "Prepare the International Conference on Advances in Radiation Oncology: Medical Physics Aspects" (jointly with ARBR), Vienna, Austria, 20-22 May 2015

Consultants' Meeting on "Investigating the Need to Update TRS 398", Vienna, Austria, (dates tbd)

Consultants Meeting to work on a publication to provide guidelines for remote/automated QC in diagnostic radiology, Leuven, Belgium, 25—27 August 2015

2nd RCM on Development of Quality Audits for Advanced Technology (IMRT) in Radiotherapy Dose Delivery, Vienna, Austria, 28 September—2 October 2015

2nd RCM to Investigate the Relationship Between End to End Accuracy and the Extent and Depth of Quality Assurance in Radiotherapy, Vienna, Austria, 28 September—2 October 2015

1st RCM of the CRP on Evaluation and Optimization of Clinical Performance in Paediatric Diagnostic Radiology, Vienna, Austria, 16—20 November 2015

1st RCM of the CRP on "Testing of the Code of Practice on Small Field Dosimetry", Vienna, Austria, 23—27 November 2015 (tentative)

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