

**IAEA**

**International Atomic Energy Agency**

*Atoms for Peace*

***IAEA Resources in Dosimetry  
and Medical Radiation Physics***

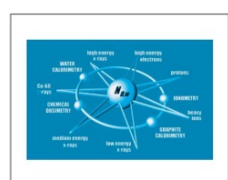
1 July 2015

## IAEA resources in Dosimetry and Medical Radiation Physics

The overall goal 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 diseases through the application of nuclear techniques. The IAEA support in medical radiation physics covers radiotherapy and diagnostic imaging (nuclear medicine, and diagnostic and interventional radiology) and includes the provision of basic dosimetry services to Member States that have no national dosimetry infrastructure. The main IAEA activities are given below, including links to recent IAEA publications.

### 1. Radiation dosimetry

- The IAEA has maintained an interest in standardization and development of Codes of Practice (CoP) for radiotherapy dosimetry going as far back as the seventies, with several publications in the field. One important example is the development of TRS-398 (2000), based on absorbed dose to water standards. TRS-398 is presently used by many physicists involved with dosimetry in radiation therapy, and has been adopted by several countries as their national dosimetry protocol. TRS-398 is also available in Russian and Spanish.



TECHNICAL REPORTS SERIES No. 398



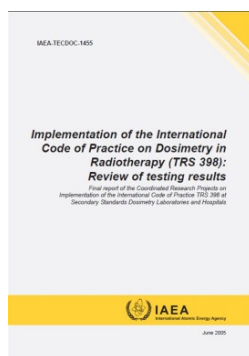
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 2000

#### [Absorbed Dose Determination in External Beam Radiotherapy](#) [An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water](#)

#### Technical Reports Series 398

Publication: STI/DOC/010/398  
IAEA, 2000

- To support the implementation of TRS-398 in hospitals and in calibration laboratories, the IAEA has published TECDOC-1455 giving the results of an extensive testing of the CoP through a coordinated research project.



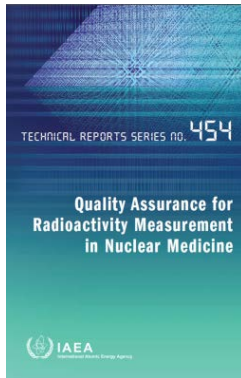
#### [Implementation of the International Code of Practice on Dosimetry in Radiotherapy \(TRS 398\): Review of Test Results](#)

#### IAEA TECDOC 1455

Publication: IAEA-TECDOC-1455  
IAEA, 2005

An extension of the existing Codes of Practice to provide recommendations on dosimetry procedures for small and composite radiotherapy fields is under preparation at the IAEA by the working group consisting of international experts.

- For nuclear medicine, the IAEA has published TRS-454 “Quality Assurance for Radioactivity Measurement in Nuclear Medicine”. The publication is based on the QA principles of ISO/IEC 17025, which describe the requirements that testing and calibration laboratories must meet to demonstrate that they have a quality system in place and are technically competent.

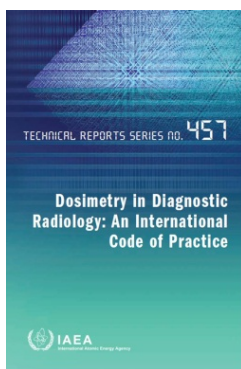


### [Quality Assurance for Radioactivity Measurement in Nuclear Medicine](#)

#### Technical Reports Series 454

Publication: STI/DOC/010/454  
IAEA, 2006

- In diagnostic and interventional radiology, a CoP to aid in the standardization of various dosimetry techniques was published as TRS-457 (2007)

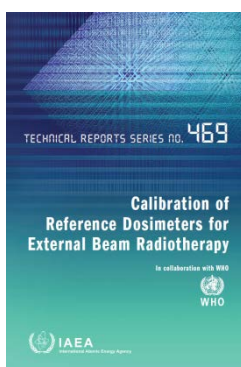


### [Dosimetry in Diagnostic Radiology: An International Code of Practice](#)

#### Technical Reports Series 457

Publication: STI/DOC/010/457  
IAEA, 2007

- This publication fulfils the need for an internationally unified approach to the calibration of ionization chambers in terms of air kerma and absorbed dose to water in the low and medium energy X ray and cobalt-60 beams used for external beam radiotherapy. This publication also includes the most recent international guidance on quality management systems applicable to standards laboratories.

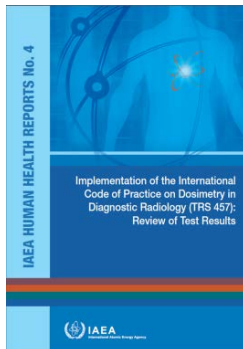


### [Calibration of Reference Dosimeters for External Beam Radiotherapy](#)

#### Technical Reports Series 469

Publication: STI/DOC/010/469  
IAEA, 2009

- To support the implementation of TRS-457 in hospitals and in calibration laboratories, the IAEA has published the Human Health Report No.4, giving the results of an extensive testing of the CoP through a coordinated research project.

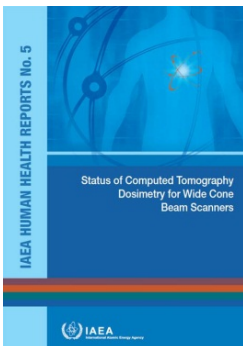


### [Implementation of the International Code of Practice on Dosimetry in Diagnostic Radiology \(TRS 457\): Review of Test Results](#)

#### **IAEA Human Health Reports 4**

Publication: STI/PUB/1498  
IAEA, 2011

- This publication supports an interim solution to the dosimetric problems caused by modern computed tomography (CT) equipment, particular with respect to the wide X ray beam angles increasing seen in clinical practice. It reviews the development of current CT dose formalisms up to the current International Electrotechnical Commission (IEC) methodologies and presents practical measurement guidance in the implementation of new dosimetric methods needed with wide beam CT.

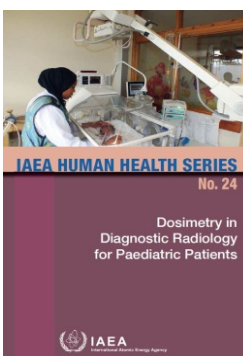


### [Status of Computed Tomography Dosimetry for Wide Cone Beam Scanners](#)

#### **IAEA Human Health Reports 5**

Publication: STI/PUB/1528  
IAEA, 2011

- For measurement and interpretation of radiation dose to children received as a result of undergoing diagnostic radiological examinations, the IAEA has published “Dosimetry in Diagnostic Radiology for Paediatric Patients”. The publication complements the work of TRS-457 and extends this work in methodologies for dosimetry in clinical environments to that required for non-adult patients.

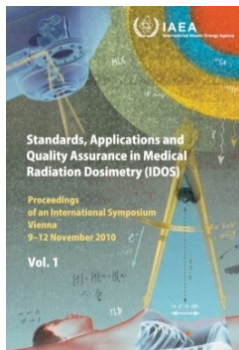


### [Dosimetry in Diagnostic Radiology for Paediatric Patients](#)

#### **IAEA Human Health Series 24**

Publication: STI/PUB/1609  
IAEA, 2013

- This publication presents the proceedings of an international symposium on standards, applications and quality assurance in medical radiation dosimetry. It includes a selection of peer reviewed papers that were presented at the symposium. The symposium provided a forum for physicists and scientists of medical institutions, research centres and standards laboratories to discuss advances in radiation dosimetry made during the past decade and to exchange scientific knowledge.



[Standards, Applications and Quality Assurance in Medical Radiation Dosimetry \(IDOS\) Proceedings of an International Symposium held in Vienna, Austria 9-12 November 2010 \(2 volumes\)](#)

**Proceedings Series - International Atomic Energy Agency**

Publication: STI/PUB/1514  
IAEA, 2011

**Also available on [CD](#)**

- An SSDL Newsletter is published bi-annually.



[SSDL Newsletter Issue No. 59, April 2011](#)

[SSDL Newsletter Issue No. 60, June 2012](#)

[SSDL Newsletter Issue No. 61, June 2013](#)

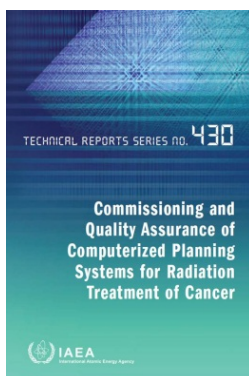
[SSDL Newsletter Issue No. 62, December 2013](#)

[SSDL Newsletter Issue No. 63, December 2014](#)

## 2. Guidelines on Quality Assurance

In the last decade the IAEA has published several technical reports and guidance documents that are a useful resource for medical physicists, in particular for equipment acceptance testing and commissioning including imaging, treatment planning and record and verify systems, as well as for quality assurance (QA) in the various areas of clinical radiotherapy physics, both for equipment and patient related procedures. The most recent publications are given below.

### 2.1 QA guidelines in radiotherapy

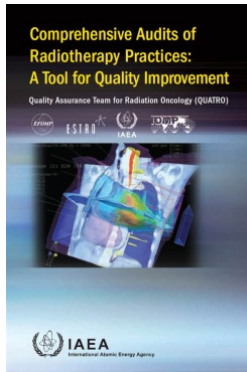


[Commissioning and Quality Assurance of Computerized Planning Systems for Radiation Treatment of Cancer](#)

**Technical Reports Series 430**

Publication: STI/DOC/010/430

IAEA, 2004

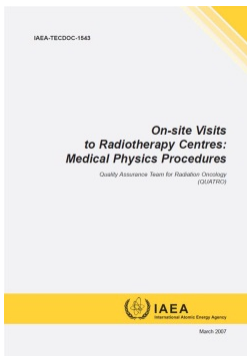


## [Comprehensive Audits of Radiotherapy Practices: A Tool for Quality Improvement Quality Assurance Team for Radiation Oncology \(QUATRO\)](#)

### Non-serial Publications

Publication: STI/PUB/1297  
IAEA, 2007

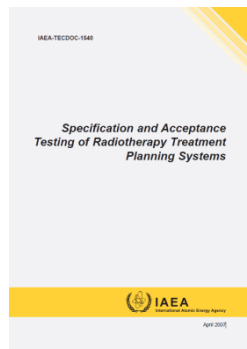
Also available in [Russian](#)



## [On-site Visits to Radiotherapy Centres: Medical Physics Procedures Quality Assurance Team for Radiation Oncology \(QUATRO\)](#)

### IAEA TECDOC 1543

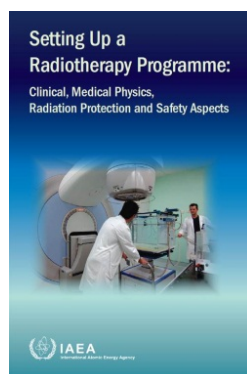
Publication: IAEA-TECDOC-1543  
IAEA, 2007



## [Specification and Acceptance Testing of Radiotherapy Treatment Planning Systems](#)

### IAEA TECDOC 1540

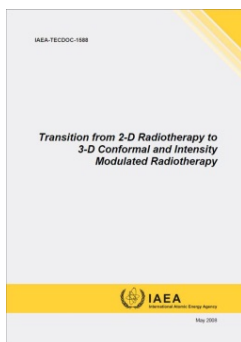
Publication: IAEA-TECDOC-1540  
IAEA, 2007



## [Setting up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspects](#)

### Non-serial Publications

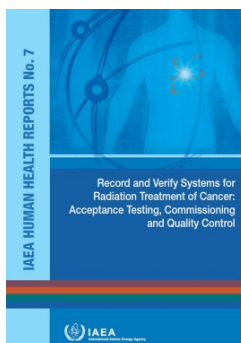
Publication: STI/PUB/1296  
IAEA, 2008



## [Transition from 2-D Radiotherapy to 3-D Conformal and Intensity Modulated Radiotherapy](#)

**IAEA TECDOC 1588**

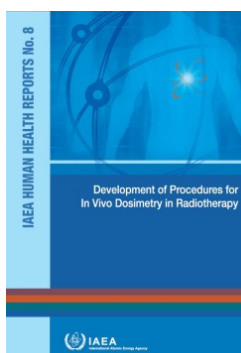
Publication: IAEA-TECDOC-CD-1588  
IAEA, 2008



## [Record and Verify Systems for Radiation Treatment of Cancer: Acceptance Testing, Commissioning and Quality Control](#)

**IAEA Human Health Reports 7**

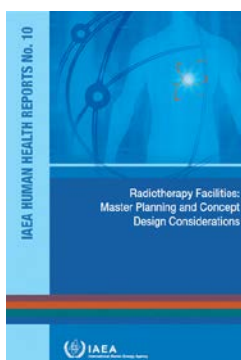
Publication: STI/PUB/1607  
IAEA, 2013



## [Development of Procedures for In Vivo Dosimetry in Radiotherapy](#)

**IAEA Human Health Reports 8**

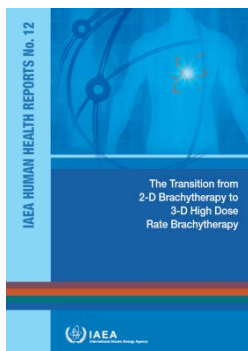
Publication: IAEA-TECDOC-CD-1588  
IAEA, 2013



## [Radiotherapy Facilities: Master Planning and Concept Design Considerations](#)

**IAEA Human Health Reports 10**

Publication: STI/PUB/1645  
IAEA, 2014

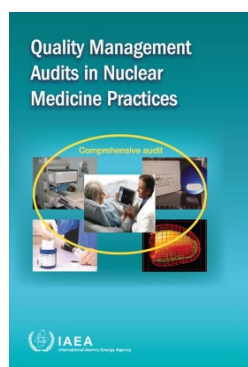


## [The Transition from 2-D Brachytherapy to 3-D High Dose Rate Brachytherapy](#)

### IAEA Human Health Reports 12

Publication: STI/PUB/1681  
IAEA, 2015

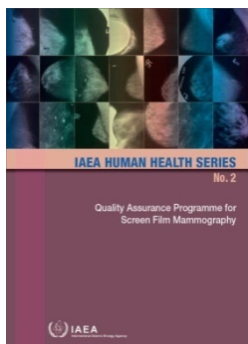
## 2.2 QA guidelines in imaging



## [Quality Management Audits in Nuclear Medicine Practices](#)

### Non-serial Publications

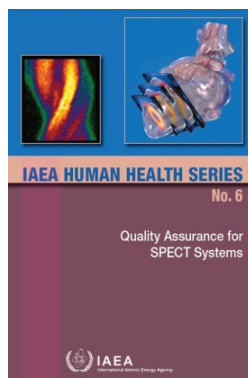
Publication: STI/PUB/1371  
IAEA, 2008



## [Quality Assurance Programme for Screen-film Mammography](#)

### IAEA Human Health Series 2

Publication: STI/PUB/1381  
IAEA, 2009

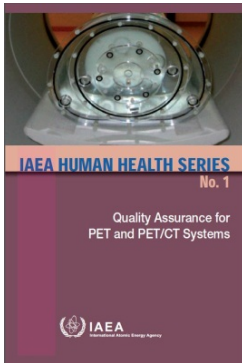


## [Quality Assurance for SPECT Systems](#)

### IAEA Human Health Series 6

Publication: STI/PUB/1394  
IAEA, 2009

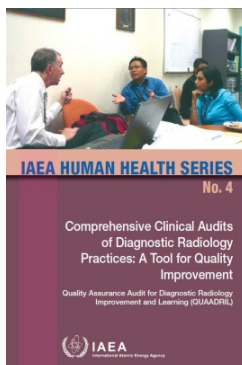




## [Quality Assurance for PET and PET/CT Systems](#)

### IAEA Human Health Series 1

Publication: STI/PUB/1393  
IAEA, 2009

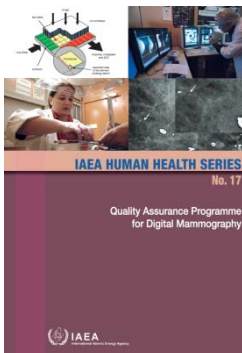


## [Comprehensive Clinical Audits of Diagnostic Radiology Practices: A Tool for Quality Improvement](#) [Quality Assurance Audit for Diagnostic Radiology Improvement and Learning \(QUAADRIL\)](#)

### IAEA Human Health Series 4

Publication: STI/PUB/1425  
IAEA, 2010

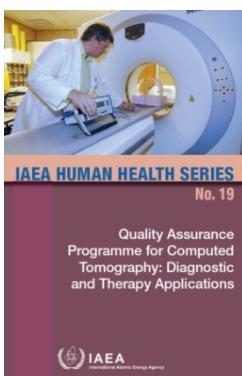
**Also available in [Spanish](#)**



## [Quality Assurance Programme for Digital Mammography](#)

### IAEA Human Health Series 17

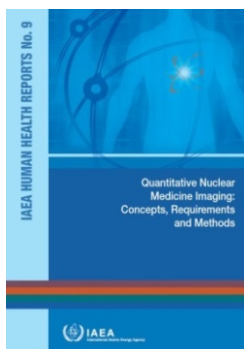
Publication: STI/PUB/1482  
IAEA, 2011



## [Quality Assurance Programme for Computed Tomography: Diagnostic and Therapy Applications](#)

### IAEA Human Health Series 19

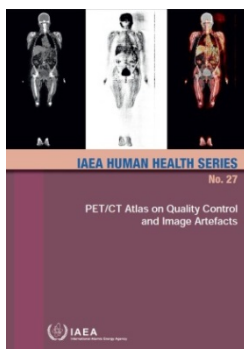
Publication: STI/PUB/1557  
IAEA, 2012



## [Quantitative Nuclear Medicine Imaging: Concepts, Requirements and Methods](#)

### IAEA Human Health Reports 9

Publication: STI/PUB/1605  
IAEA, 2014



## [PET/CT Atlas on Quality Control and Image Artefacts](#)

### IAEA Human Health Series 27

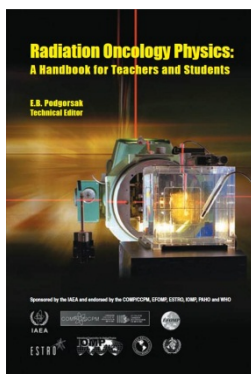
Publication: STI/PUB/1642  
IAEA, 2014

## 3. Education and Training

The IAEA has published several reports and e-learning material to support education and training of medical physicists, including specific guidance for establishing and implementing clinical residency programmes. The list is given in “3.1 Education and training material”. The IAEA Human Health Campus (<http://nucleus.iaea.org/HHW/MedicalPhysics/index.html>) serves as a resource for health care professionals and students in radiation medicine.

In addition, the IAEA provides support for scientific visits and practical training through its Technical Cooperation (TC) programme. Specific guidance on how to participate in this TC programme is given in “3.2 Technical Cooperation programme”.

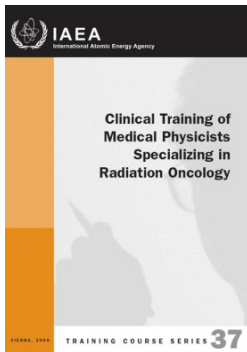
### 3.1 Education and Training material



## [Radiation Oncology Physics: A Handbook for Teachers and Students](#)

### Non-serial Publications

Publication: STI/PUB/1196  
IAEA, 2005

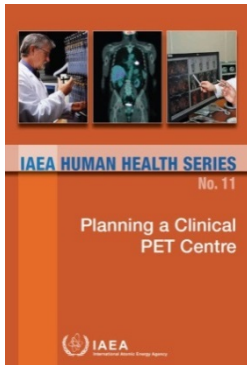


## [Clinical Training of Medical Physicists Specializing in Radiation Oncology](#)

### **Training Course Series 37**

Publication: IAEA-TCS-37  
IAEA, 2009

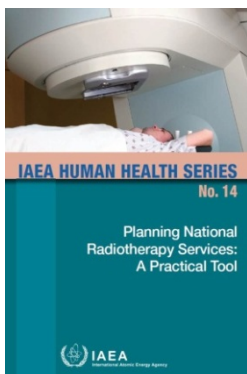
**Also available in [Spanish](#), [French](#), [Russian](#)**



## [Planning a Clinical PET Centre](#)

### **IAEA Human Health Series 11**

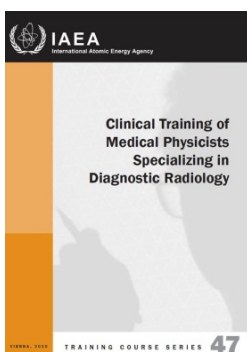
Publication: STI/PUB/1457  
IAEA, 2010



## [Planning National Radiotherapy Services: A Practical Tool](#)

### **IAEA Human Health Series 14**

Publication: STI/PUB/1462  
IAEA, 2010

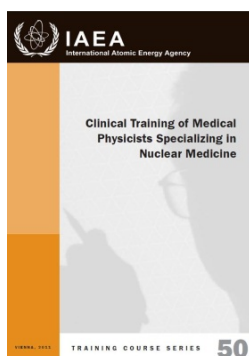


## [Clinical Training of Medical Physicists Specializing in Diagnostic Radiology](#)

### **Training Course Series 47**

Publication: IAEA-TCS-37  
IAEA, 2010

**Also available in [French](#), [Spanish](#)**

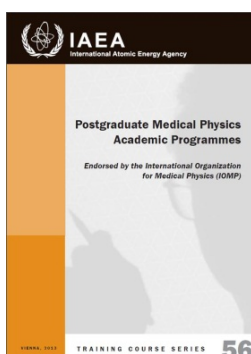


## [Clinical Training of Medical Physicists Specializing in Nuclear Medicine](#)

### Training Course Series 50

Publication: IAEA-TCS-50  
IAEA, 2011

**Also available in [French](#), [Spanish](#)**



## [Postgraduate Medical Physics Academic Programmes](#)

### Training Course Series 56

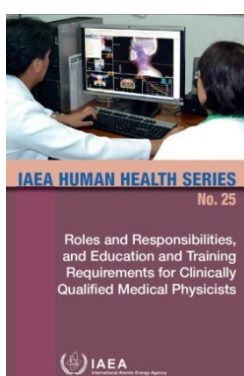
Publication: IAEA-TCS-56  
IAEA, 2013



## [Transitioning from 2-D Radiation Therapy to 3-D Conformal Radiation Therapy and Intensity Modulated Radiation Therapy: Training Material](#)

### Training Course Series (CD-ROM) 55

Publication: IAEA-TCS-55/CD  
IAEA, 2013



## [Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists](#)

### IAEA Human Health Series 25

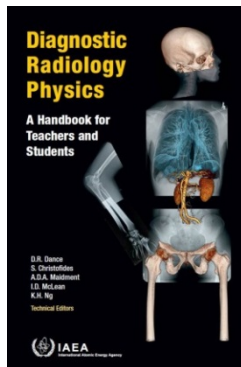
Publication: STI/PUB/1610  
IAEA, 2014

**Also available in [Russian](#), [Spanish](#)**

- Training module to assist medical physicists in the implementation of IAEA Technical Report Series No. 398 for high energy linear accelerator photon beams (chapter 6).

<http://www-naweb.iaea.org/elearning/DMRP/trs398/player.html>

- Diagnostic Radiology Physics: A Handbook for Teachers and Students, Non-serial Publications, IAEA

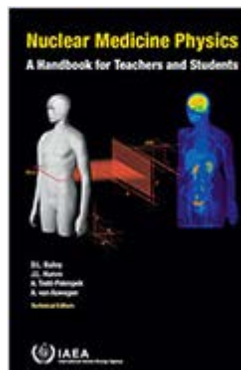


## [Diagnostic Radiology Physics: A Handbook for Teachers and Students](#)

### Non-serial Publications

Publication: STI/PUB/1564  
IAEA, 2014

- Nuclear Medicine Physics: A Handbook for Teachers and Students, Non-serial Publications, IAEA



## [Nuclear Medicine Physics: A Handbook for Teachers and Students](#)

### Non-serial Publications

Publication: STI/PUB/1617  
IAEA, 2015

## 3.2 Technical Cooperation

Through the technical cooperation programme and within approved national and/or regional projects, IAEA support is given for setting up or improving QA programmes in hospitals, setting up national medical physics education and clinical training programmes. In addition, support is also granted for setting up or upgrading national calibration laboratories and for the establishment of national dosimetry audit programmes. For training, fellowships and scientific visits are planned and implemented within TC projects for professionals working in the field. Specialized training and workshops are organized at the national and regional level in specialized topics.

To support hands-on training acceptance testing and quality control of medical physics aspects in nuclear medicine, the IAEA has setup a gamma camera lab with the kind support of an equipment supplier. The laboratory is also equipped with quality control tools and equipment, and radioisotopes are procured when training events are held (see picture below). Group Training is organized at the IAEA Gamma Camera Laboratory, through TC projects.

Detailed information on how to take part in the IAEA TC programme is given in <http://www.iaea.org/technicalcooperation/How-to-take-part/index.html>

#### 4. IAEA Dosimetry services

The IAEA's Dosimetry Laboratory, located in Seibersdorf, is the central laboratory of the IAEA/WHO network of Secondary Standard Dosimetry Laboratories (SSDLs). Its mandate is (i) to develop, implement and maintain standards for dosimetry measurements in radiotherapy, diagnostic radiology and radiation protection, (ii) to provide dosimetry calibration services for SSDLs and to reference hospitals in countries where no SSDLs exist, and (iii) to provide dosimetry audit and verification services for applications in radiotherapy and radiation protection for SSDLs, hospitals and radiation protection services in Member States. In addition, the training of SSDL staff from Member States constitutes part of the Dosimetry Laboratory mandate.

The Dosimetry Laboratory provides link between SSDLs and the International System of Units by disseminating metrology standards for radiation measurements in the fields of radiation protection and radiation medicine (radiotherapy and diagnostic X rays). To operate the Dosimetry Laboratory to the highest quality levels, a quality management system has been established following the requirements of ISO/IEC 17025.

The services available through the IAEA's Dosimetry Laboratory include:

- Calibration of national dosimetry standards for Member States that have no primary standards. The IAEA Calibration and Measurement Capabilities (CMCs) are internationally peer-reviewed and approved by the Joint Committee of the Regional Metrology Organizations and the BIPM. The list of approved CMCs is given in the BIPM Key Comparison Data Base ([http://kcdb.bipm.org/AppendixC/RI/IO/RI\\_IO.pdf](http://kcdb.bipm.org/AppendixC/RI/IO/RI_IO.pdf)). An SSDL Newsletter is published bi-annually. The PDF files can be downloaded from: [http://www-pub.iaea.org/books/IAEABooks/View\\_Newsletters/78/SSDL-Newsletter](http://www-pub.iaea.org/books/IAEABooks/View_Newsletters/78/SSDL-Newsletter)
- Comparison of national dosimetry standards: bilateral dosimetry comparisons with the IAEA can be organized to verify then integrity of the national dosimetry standard.
- Postal dosimetry audits of radiation beams in radiotherapy hospitals and at SSDLs. Thermoluminescent dosimetry (TLD) is utilized as the basis of the IAEA's dose audits in radiotherapy, which have been conducted in cooperation with WHO since 1969. In this service, a small plastic tube containing TLD powder is irradiated to a specified dose by the medical physicist in the hospital, following the same procedure as prescribed for patient treatment. The TLDs are returned to the IAEA Dosimetry Laboratory for readout and analysis. The dose received by the TLD is compared with the intended dose stated by the hospital staff. For participants with inconsistent results, the IAEA establishes a follow-up programme for quality improvement, including on-site visits by local or international experts. Similar services are provided to SSDLs for radiotherapy and radiation protection level dosimetry.
- The Dosimetry Laboratory accepts fellows for training through the IAEA Technical Co-operation programme.

More information on Dosimetry Laboratory services can be found on

- <http://www-naweb.iaea.org/nahu/DMRP/laboratory.html>
- <http://nucleus.iaea.org/HHW/MedicalPhysics/Radiotherapy/Qualityauditinradiotherapy/index.html>

Dosimetry Laboratory services can be requested by contacting [dosimetry@iaea.org](mailto:dosimetry@iaea.org).

IAEA websites for medical physics

- <http://www-naweb.iaea.org/nahu/DMRP/about.html>
- <http://nucleus.iaea.org/HHW/MedicalPhysics/index.html>

For additional information on IAEA support and resources in medical radiation physics, please contact [dosimetry@iaea.org](mailto:dosimetry@iaea.org)