GENERIC SPECIFICATION 3DSWPH02
3D Scanning Water Phantoms for Radiotherapy Dosimetry

1. Scope

1.1. This Specification describes the standard requirements for a 3D scanning water phantom for automated beam data acquisition and quality assurance of the teletherapy units (hereinafter referred to as "the System").

1.2. Requests to vary from this Specification must be supplied with supporting evidence and are subject to approval of the IAEA technical officer.

2. Applicable Documents

The following documents shall be applicable for this Specification to the extent specified hereinafter:

2.1. International Electrotechnical Commission, Medical electrical equipment - Dosimeters with ionization chambers as used in radiotherapy IEC 60731;2011.

2.2. International Electrotechnical Commission, Radiotherapy Equipment - Co-ordinates, Movements and Scales, Rep. IEC 61217;2011.

2.3. Specification and Acceptance Testing of Radiotherapy Treatment Planning Systems (TECDOC-1540);2007

2.4. Commissioning and Quality Assurance of Computerized Planning Systems for Radiation Treatment of Cancer Technical Reports Series No. 430 (STI/DOC/010/430); 2005

2.5. 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 No. 398, STI/DOC/010/398); 2000

2.6. Dosimetry of Small Static Fields Used in External Beam Radiotherapy (Technical Reports Series No. 483, STI/DOC/010/483, Vienna 2017).

In the event of conflict between the documents listed above and the content of this Specification, the content of this Specification shall take precedence to the extent of the conflict.

3. Definitions, Acronyms, and Abbreviations

The following definitions, acronyms, and abbreviations shall apply throughout this Specification unless defined otherwise hereinafter:

PDD: percent depth dose

TMR: tissue maximum ratio

TPR: tissue phantom ratio

SSD: source surface distance

4. Requirements

4.1. Functional and Performance Requirements

The System shall include the following equipment and functionality:

4.1.1. A portable water tank, reservoir, lift table, controller, dual-channel electrometer, detectors, software and computer capable of automated measurement of relative beam dosimetry, suitable for setup with the identified radiotherapy treatment equipment.

4.1.2. The relevant software and license for the generation of beam data file, suitable for export to the defined treatment planning system.

4.2. Technical Requirements

The System shall meet the following technical requirements:

4.2.1. Acrylic water tank with minimum scanning range of 480 x 480 x 400 mm^3 in x, y and depth axes respectively;
4.2.2. Detector position accuracy: ± 0.1 mm and position reproducibility: ± 0.1 mm;
4.2.3. Water tank with a motorized scanning capability in user-defined points and planes, including depth, diagonal and profile scans, for various ionization chambers/detectors
4.2.4. Computer-controlled reservoir pump, sensor and lift table with a minimum vertical travel range of 500 mm for positioning the detector for TPR/TMR measurements.
4.2.5. Provision for levelling the scanning arm(s) of the water phantom
4.2.6. Water valve keeping the waterflow under control
4.2.7. The control unit that controls the movement of the ion chambers in XYZ direction and acquires detector data from the electrometer
4.2.8. A transportable water reservoir required for filling and draining the scanning tank with bidirectional water flow;
4.2.9. One portable laptop computer with Windows operating system with connectivity to the control unit and dosimetry server;
4.2.10. Wired connection (Minimum 25 m) between the portable laptop computer (with required interface and software driver) and the control unit of the water tank, in adequate quantity for the number of radiotherapy treatment equipment installed;
4.2.11. Equipment for dosimetry
  4.2.11.1. A dual electrometer and control unit with bias range: 0 through +/- 400 V, minimum resolution of 10 fA, and leakage current < 250 fA; with connector suitable for this User;
  4.2.11.2. Two (2) waterproof cylindrical or spherical ionization chambers (Active volume approximately 0.13 cm^3) for relative dosimetry with holders for use as scanning and reference chambers.
  4.2.11.3. Two (2) cables compatible with ionization chamber detectors and dual electrometer; and

4.2.12. Software with one License for beam data acquisition with scan optimization (variable speed and resolution), data handling and analysis and Treatment Planning System (TPS) transfer environment;
  4.2.12.1. software feature to allow export of beam profile data (full and half), TPR/TMR or depth dose data in ASCII format;
  4.2.12.2. software module shall allow conversion, processing, modelling and transfer of beam data to the identified treatment planning system(s).
  4.2.12.3. software capable to perform beam data analysis according to various protocols:
    4.2.12.3.1. AAPM-TG51
    4.2.12.3.2. IEC 60976
    4.2.12.3.3. IPEM
    4.2.12.3.4. IAEA TRS398
    4.2.12.3.5. IAEA TRS483
  4.2.12.4. software shall include:

4.2.12.4.1. Generation of TMR from PDD measurements;

4.2.12.4.2. Generation of PDDs from relative ionization measurements with electron beams, if applicable.

5. Marking

The System shall have all safety markings in the English, and if available country-specific languages.

6. Packing

The System, for shipment to the User, shall be packed in accordance with international standards that are applicable for the shipment by air/road of this kind of equipment.

7. Quality Requirements

7.1. The System shall be manufactured, packed and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system.

7.2. The Contractor shall document the compliance with this quality assurance system.

8. Testing and Acceptance

8.1. The System, prior to shipment, shall be tested for conformance of the System with manufacturer's performance specifications and the minimum requirements specified herein.

8.2. The System, after installation, shall be tested by the Contractor together with the End-User to demonstrate that the performance meets the manufacturer's performance specifications and the minimum requirements specified herein.

8.3. The results of the testing shall be documented by the Contractor in an acceptance protocol that shall be signed by the End-User.

9. Installation and Training

9.1. The Contractor shall install the System at the End-User's location

9.2. The Contractor shall provide two (2) days training for up to three (3) medical physics staff of the End-User in the operation and maintenance of the System at the End-User's location immediately after the installation of the System.

10. Deliverable Data Items

The Contractor shall provide two (2) complete sets of operation manuals in the English, and if available country-specific languages.