SPECIFICATION

Dynamic Thorax Phantom

1. Scope

   This specification describes the requirements for a Dynamic Thorax Phantom (hereinafter referred as "the System") which simulates lesion movements inside the lungs which will be used in the; Universidad de Costa Rica, Centro de Investigación en Ciencias Atómicas, Nucleares y Moleculare (CICANUM), Costa Rica (hereinafter referred as "End-User) under the IAEA TC Project COS6027.

2. Applicable Documents

   N/A

3. Definitions, Acronyms, and Abbreviations

   N/A

4. Requirements

   4.1. Functional and Performance Requirements

   4.1.1. Shall be a precision instrument for investigating and minimizing the impact of tumor motion inside the lung.

   4.1.2. Shall provide accurate and repeatable three-dimensional target motion inside a tissue equivalent phantom. The aim of the phantom is to provide a comprehensive analysis of image acquisition, planning and dose delivery in image-guided radiation therapy.

   4.1.3. Shall have a lung equivalent rod containing a spherical target and/or various detector is inserted into the lung equivalent lobe of the phantom, moreover, the body shall be connected to a motion actuator box that has to include three-dimensional target motion through linear translation and rotation of the lung equivalent rod. Motion of the rod itself is radiographically invisible due to its matching density with the surrounding material. The target and its motion, give its density difference, can be resolved.

   4.1.4. Target and surrogate motion shall be controlled using a design software for it, then, a graphical user interface must be provided with unlimited variety of motions while simplifying the operation of the phantom.

   4.2. Technical Requirements

4.2.1. Overall dimensions: 26" x 13" x 11" (67 cm x 32 cm x 28 cm).
4.2.2. Overall weight: 17.2 kg.
4.2.3. Motion accuracy: ± 0.1 mm
4.2.4. Amplitude, surrogate: ± 25 mm
4.2.5. Amplitude, IS: ± 25 mm
4.2.6. Amplitude, AP/LR: ± 5.0 mm
4.2.7. Cycle time: from 1 to infinity (adjustable based on amplitude
4.2.8. Waveforms: sin(t), $1-2\cos^4(t)$, $1-2\cos^6(t)$, sawtooth, sharfin
4.2.9. Maximum surrogate platform load: 5.4 kg
4.2.10. Power supply: 110 VAC, 50/60 Hz
4.2.11. Independent control surrogate motion device shall be provided
4.2.12. Control software system shall be provided
4.2.13. Computer for the control software system shall be provided with the operational platform for it (windows/linux). The computer shall meet the manufacturer's requirements
4.2.14. The Motion controller system shall connect to the computer used with the computer interphase.
4.2.15. The Motion controller system shall have a connection with the equipment which provided the movement (actuator) of the tumor (insert) within the phantom. The actuator shall contain an adjustable device used for levelling the actuator couch.
4.2.16. Chest plate for collecting chest motion and breathing data using optical tracking systems shall be provided.
4.2.17. Body phantom shall be tissue equivalent from 50 keV to 15 MeV.
4.2.18. Body phantom shall include at least the following tissues: Lung, cortical bone, trabecular bone, soft tissue target.
4.2.19. Technical specifications of the tissues shall be provided, for instance: density, electron density, ration to water, elemental composition, mass fraction.
4.2.20. Body phantom shall include internal landmarks.
4.2.21. The following interchangeable inserts for QC and dosimetry must be provided: PET/CT insert, Gel dosimetry insert, 4D CT QA insert, micro chamber insert, imaging insert, SBRT Rod Insert, OSL dosimetry rod insert
4.2.22. All provided equipment/devices/phantoms/inserts shall be the latest versions.

5. Marking

The System shall have all safety markings in English language.

6. Packing

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

7. Quality Requirements

   7.1. All provided equipment/devices/phantoms/inserts shall be manufactured, shipped 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 All provided equipment/devices/phantoms/inserts shall be fully accepted by the end-user after testing the provided items.

   8.2 Warranty shall be for a 12-month period.

9. Deliverable Data Items

   The Contractor shall provide all manuals in English language.

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