CT Simulator Machine

No.	Item Specification	Fill Your Specifications
1	**Definition**	
1.1	Dedicated CT Simulator is required for Radiotherapy Department for advanced Simulation for planning, conventional, 3-D CRT, IMRT, IGRT Planning. The CT-Simulator is required for most accurate simulation, placement of treatment fields and marking of radiation field portals on the patient ‟s skin for radiation therapy of cancer patients. The CT scanner should have carbon fiber tabletop with indexing facilities (for all kinds of immobilization system used in radiotherapy) identical to that of linear accelerators in the department. The CT- simulator should have at least three computer controlled moving lasers for marking the field reference points, consists of a single overhead moving laser to project the sagittal plane, two moving lasers to project coronal plane and two moving lasers to project the axial plane. This should eliminate the need for manual couch movements. The CT scanner should be a spiral, multi-slice should ensure easy, error free and total compatibility between the scanner and simulation work station. If third party software is supplied, it will be sole responsibility of the vendor incorporating latest technology available in the market. The Simulation software should be user friendly and supplying the CT simulator to run the software. The system should be able to integrate the Virtual simulation Software, work station to existing and future2 D TPS, 3D TPS, Linear accelerator and Cobalt 60 machine of the department and this will be entirely and directly responsibility of the vendor	
2	**CT Scaner**	
2.1	Whole body spiral, multi-slice (minimum 16 slices per rotation or more) CT scanner system should have following essential features:	
3	**Gantry**	
3.1	• Aperture should be minmum 85 cm or higher.	
3.2	• Focus –Isocentre distance≥ 700 mm.	
3.3	• Focus –detector distance≥ 1240 mm.	
3.4	• Position light and accuracy laser ,±1mm.	
3.5	• Rotation times for helical scanning(s)≤0.5	
3.6	• Mention if tilt for helical scanning is possible	
3.7	• Scan field of view of at least 50cm or more.	
3.8	• Extended field of view of minimum 70 cm.	
3.9	• Scanned projection radiography (SPR)	
3.10	• Continues time scan (s) ≥100	
4	**Generator**	
4.1	• High frequency	
4.2	• Power ratting ≥ 80KW.	

4.3	• kVP settings available 80-100-120-130 or higher	
4.4	• mA allowed for 135 kV ≥ 400mA	
4.5	• AEC adjustment	
4.6	• Should be micro processor controlled, low noise, high frequency rotation assembly with facility for continuous monitoring with self test system	
4.7	• Software for automatic mA control, mA adjustment for patient size and mA modulation during rotation and mA adjustment along z axis should be available	
5	**Detector**	
5.1	• Solid state array	
5.2	• slices/rotation =16	
5.3	• Reconstruction fields of view (cm) ≥ 50	
5.4	• Real time image reconstruction.	
5.5	• Resolution (lp/cm) for sharpest clinical algorithm ≥ 10 (lp/cm).	
5.6	• Availability of quarter detector shift	
5.7	• Number of imaging detectors per row ≥650	
5.8	• Availability of Artefact Reduction Algorithms	
5.9	• Availability of Cone Beam Correction	
5.10	• Low-Contrast Resolution, mm, at Percentage at 4 Rads ≤ 4.0 mm @ 0.3 percent.	
5.11	• The detector system should be a high performance, low noise, high data density, active response data acquisition system. Please describe your detector.	
5.12	• It should be free from repeated calibrations.	
6	**Tube**	
6.1	• Anode heat capacity ≥ 7MHU with at least 80% full loading.	
6.2	• Guaranteed tube life ≥ 200.000 rotation.	
6.3	• Forced cooling system	
6.4	• State the half value layer of x-ray beam @ 120 kVP .	
6.5	• State Dual focus spot size.	
6.6	• Maximum anode cooling rate (kHU/min) ≥ 900	
7	**Dose**	
7.1	• State the Dose Length Product (DLP).	
7.2	• State the Weighted CTDI (CTDIW) displayed on console.	
7.3	• State the CTDI (mGy/100 mAs) for axial standard brain and abdomen .	
7.4	• Specify Automatic mA adjustment according to body dimensions or density during examination.	
8	**DICOM service classes**	
8.1	• Storage: storage commitment ,print, archive, work list ,query /retrieve ,performed procedure step DICOM RT import/export	
8.2	• DICOM radiotherapy protocol compatibles with linear accelerator, treatment planning system and record & verification send and receive include counter tumor mark and volume	
9	**Data processing**	

9.1	• Specify reconstruction algorithm	
9.2	• Beam hardening algorithm , noise reduction algorithm , Artefact reduction algorithm, 2D helical scanning reconstruction	
9.3	• Workstation compatible with PACS and DICOM RT.	HIS and RIS
9.4	• External access to workstation	
9.5	• Shared image data base	
9.6	• Metal Artifact Reduction (Dynamic Range, Algorithm, Protocol) ,Advanced artifact reduction.	
10	**Mandatory Requirement**	
10.1	• Automatic Contrast injector	
10.2	• Automated Contrast Injector Timing	
10.3	• Phantom Specifically Developed for CT Simulation and RTP with QC .	
10.4	• Quality control accessories and phantom (CATPHAN ,LASER alignment ,diagnostic QC tools.	
10.5	• Special quality control kits such as ACR phantom and AEC phantom for calibration of image detector.	
10.6	• Special quality control software.	
10.7	• Quality control procedure	
11	**Operating console Computer**	
11.1	• Processor should be minimum 64 bits/5 GIPS or higher, Hard disk of 12 GB higher capacity disk will be prefered. RAM should be 2 GB or more.	
11.2	• CT Simulator should be fully DICOM compliant.	
11.3	• Should have space for storage of raw data.	
11.4	• It should have 19´´ or more (flat panel) colour monitor for display of 1024 X 1024 matrix or more	
11.5	• All functions viz scanning, image reconstruction, film documentation, MPR, CT maximum intensity projection, 3D with SSD, virtual simulation etc should be possible from main console and workstation	
11.6	• DVD/CD/ or better archiving facility must be available.	
11.7	• The image reconstruction time should be less than 1.5 second for any mode	
12	**Standards Workstation**	
12.1	• MINIP,	
12.2	• MPR,	
12.3	• SSD	
12.4	• Segmentation	
12.5	• Volume Rendering Software	
12.6	• Archive data of row and image	
12.7	• Dicom radiotherapy.	
13	**Clinical Application Software**	

13.1	• Standard :	
13.1.1	○ Virtual Oncology.	
13.1.2	○ 3D reconstruction @ SSD.	
13.1.3	○ It should be possible to simulate all kinds of Tele-therapy machines in the simulation workstations. It should conform to IEC and other international standard norms and support cobalt therapy, linear accelerator of all types, and other user defined linear accelerator and compatible with multileaf collimator of all the vendors.	
13.2	• Basic for diagnosis :	
13.2.1	○ Angiography	
13.2.2	○ Virtual endoscopy	
13.2.3	○ Brain perfusion	
13.2.4	○ Image fusion	
13.2.5	○ Assisted software for : lung ,colon , bone densitometry ,dental.	
13.2.6	○ The software should have a volume accelerator for high speed 3D rendering at full spatial resolution.	
13.2.7	○ On the monitor screen it should be possible to view at least 36 images or more.	
13.2.8	○ The standard screen layout should consist of one main view port and three Sub-view ports for frequent usage of other images, quick manipulation of Images, or for displaying reference views, while the main view port is used for high resolution display.	
13.2.9	○ Image manipulation such as changing window width and window level, hot keys activated automated study archive, deletion, screen layout changes, disk space display, archiving, and graphic overlays such as annotation.	
14	**Respiratory Gating software**	
14.1	• The machine should have both prospective and retrospective respiratory gating module.	
15	**Radiotherapy application**	
15.1	• Planning index table	
15.2	• External positioning laser	
15.3	• Respiratory gating software	
15.4	• Radiotherapy CT simulation software	
15.5	• CT fluoroscopy in room capability	
15.6	• CT perfusion analysis	
15.7	• Volume of Interest (VOI) Cutaways for DRRs/DCRs	
16	**spare part & technical support**	
16.1	• The company must support 15 years life span of the supplied machine along with software, spare parts and supplied accessories with payment	
16.2	• Annual price list of spare part for 15 years	
17	**Image display**	
17.1	• Diagnostic grade ,LCD ,resolution≥ 1.3Mpixel,image matrix ≥1K*1K, accuracy of distance measurement (xy)2mm,CT number display≥ +1024 to -8169, extended CT number display ,CT number accuracy ≤10, CT number uniformity ≤3	
17.2	• monitors at console ≥ 2 (acquisition/ review and processing)	
18	**Image Quality**	

18.1	• The reconstruction matrix must be 512 x 512 or higher. The reconstruction time should be as less as possible. Simultaneous scanning and reconstruction should be possible. It should be possible to do:	
18.2	• 1. Simultaneous scanning & routine analysis.	
18.3	• 2. Simultaneous scanning & archiving and / or hard copying and	
18.4	• 3. Simultaneous scanning and transfer to second console / workstation.	
18.5	• The system must have automatic mA control software that automatically adjusts mA for patient size, adjust mA along the z-axis, modulates mA during rotation.	
19	**Control console**	
19.1	• All functions via scanning, image reconstruction, film documentation, MPR, CT maximum intensity projection, 3D with SSD, virtual simulation etc should be possible from main console and workstation.	
19.2	• MINIP	
19.3	• MPR	
19.4	• SSD	
19.5	• Segmentation	
19.6	• Volume Rendering Software	
19.7	• Reconstruction times ≤ 30 S	
19.8	• DVD/CD/ or better archiving facility must be available.	
19.9	• The image reconstruction time should be less than 1.5 second for any mode.	
20	**Spiral Parameter**	
20.1	• Different selection of pitch should be possible, from 0.5 to 3 mm in 0.1mm increments. Please mention the pitch available. Mention the single run coverage and the table scannable range. Inter Scan Delay in different group of spiral should not be more than 5 sec.	
20.2	• Intra-plan delay of 5 sec or more should be possible	
20.3	• Retrospective reconstruction should be possible on raw data files with change in parameters such as FOV .	
20.4	• The following scanning modes should be possible: Scanogram, Axial, Spiral, Cine and biopsy mode .	
20.5	• Pilot scan: The pilot scan field size should be more than 1500 mm long. The reconstruction time for pilot scan should be 3 secs for a 512 matrix and 5 secs for a matrix of larger size	
20.6	• Reference scan should be possible on an arbitrary slice within the proposed treatment volume	
20.7	• Specify the table speed to the scan in terms of Z-axis coverage.	
21	**Patient Couch**	

21.1	• The scanning couch top must be carbon fiber flat table top with minimum dimensions of 35 cm X 40 cm, having horizontal moving range of 170 cm or more and should be compatible with the tables of the linear accelerators installed in the department. The table should have patient positioning index system on carbon fiber table top	
21.2	• It should be possible to move the carbon fiber flat table top from the table side.	
21.3	• Pitches available for routine scanning ≤ 2mm	
21.4	• longitudinal movement range(cm) ≥180	
21.5	• Maximum weight on couch (kg) ≥220 without any change in stated performance specification.	
21.6	• Vertical movement range out of ≥ gantry (cm) 50 – 99 .	
21.7	• The speed of horizontal movement must be variable with a maximum speed of at least 10 mm per second.	
21.8	• The accuracy (reproducibility) of the table top must be better than ± 0.25 mm.	
21.9	• The scannable longitudinal range should be at least 150 cm or more.	
21.10	• Specify the minimum height of the table outside the gantry.	
21.11	• With minimum dimensions of 235cmX40cm.	
21.12	• Table movement control should be possible from table or gantry side, control console and hand pendent.	
22	**CT Scanning Parameters**	
22.1	• The slice thickness should be users selectable starting from 1mm or less.	
22.2	• Scan time for full 360 degree rotation should be 0.5 sec. or less.	
22.3	• Intra-Plan Delay of 5 sec. or less should be possible	
22.4	• Retrospective reconstruction should be possible on raw data files with change in parameter such as FOV.	
22.5	• The following scanning mode should be possible Scanogram : Axial and Spiral. It Should be possible to mix spiral and axial mode.	
22.6	• Starting with a cold tube, the maximum helical scan distance using a 1mm imaged slice thickness and a pitch of 1.5 should be 1500 mm or more.	
22.7	• The scanogram length should be more than 1500 mm long and the width must be at least 500 mm. It must be possible to obtain the scanogram from AP or PA or left to right or right to left directions	
22.8	• The accuracy of slice prescription from the scanogram should be ± 0.5mm or better	
22.9	• High contrast spatial resolution: It should be at least 15 lp/cm maximum at 0% MTF.	
22.10	• The CT number accuracy must be better than ± 4 HU for water and ± 10 HU for air. Necessary phantoms to check the spatial resolution of the scanner should be provided. A special phantom to check the electron density - HU relationship for the different body tissues must be provided.	
22.11	• Scan field view should be 50 cm or more.	
23	**Computer system of ct scanner**	

23.1	• There must be two monitors in the console and they must be 19" LED monitors. One of these will be used for acquisition and the other will be used for review and processing	
23.2	• The hard disk capacity of the main computer system must be at least 5 TB or more. In the hard disk meant for image storage, the number of uncompressed 512 x 512 images that can be stored should be at least 250,000 images or more.	
23.4	• The maximum possible hard disk capacity must be provided. For archiving, DVD writer should be provided for providing copies of individual studies. The archiving system should provide back up for imaging needs of an average radiology facility for 2 years. All necessary hard ware and consumables (DVD / DAT cartridges) to be specified and provided.	
23.5	• DICOM compatible Printer with color laser connected with UPS to be provided .	
23.6	• The entire CT Simulation system must be interconnected (all the workstations, laser systems,	
23.7	printers etc.) and must be integrated into the department's any treatment planning systems for smooth transferring of images and DICOM-RT structures including the system .	
23.8	• The system should be compatible to be a networked with all radiotherapy treatment planning system in the department and necessary software support shall be provided for all existing external beam radiotherapy and Brachytherapy planning.	
24	**Laser System & Computer System for Moving Laser System**	
24.1	• The CT Simulator should have at least FIVE lasers. Out of which one should be mounted on the ceiling and two lasers should be mounted on side walls. The lasers should be computer controlled moving lasers.	
24.2	• The simulation work station should control the moving lasers for marking the field reference points, other than couch movement. Since the computerized moving laser marking system is of paramount importance, the vendor has to support the claim in this regard by authenticated brochures and documents. In addition to the moving laser, the CT-Scanner should have conventional in-built lasers for positioning the patient.	
24.3	• Complete quality control tools must be provide.	
25	**Essential accessories to be included with the unit**	
25.1	• Sets of patient immobilization namely head holder, positioning kit, mattresses (for diagnosis procedures) must be provided .	
25.2	• 4D Gated Phantom shall be provided	
25.3	• Lead Glass: 100 cm X 150 cm or more with lead equivalent to meet the AERB‟s radiation safety requirements.	
26	**Isocenter Management**	
26.1	• The software should support separate isocenters for multiple target volumes or general regions.	
26.2	• Marked and final isocenters should be reported and displayed in the localization package for easy confirmation of a physical simulation session.	
26.3	• Hardcopy of the isocenter coordinates should be possible for record of the simulation session.	
26.4	• Isocenter positioning should be automatic.	
26.5	• No limit on number of isocenters per target .	
26.6	**3-D View And Volume Rendering Capabilities**	

26.7	• Post processing features like volume rendering, real-time multi-axial volume reconstruction, 3-D surface rendering. Colourwash 3D should be available.	
26.8	• It should allow completed 3D volume to be defined including complex 3D volumes, user selectable multi-image views; beams eye view, room eye and DRR.	
26.9	• The DICOM compliance statement should be provided.	
26.10	• Accuracy of locating any point in 3-D should be 0.1 mm or less.	
27	**Beam Placement& Definition**	
27.1	• It should support extensive beam shapers (shielding blocks etc) and beam definition methods.	
27.2	• Manual or automatic beam placement tool.	
27.3	• Tools for real time checking of machine geometry.	
27.4	• Beam shaping should be possible in multiple ways like automatic shielding block, definition conforming to selected volume, definitions aperture or shielding manual free hand definition, automatic collimator jaw and multileaf position definition.	
27.5	• It should be possible to define this asymmetric collimator feature, where both the X- and Y-axis of jaws are asymmetric, in the CT simulation software. Similarly the software should allow multi-leaf-collimator placement up to 40 pairs or more. Any software that cannot handle 40 pairs of MLC leaves is not acceptable .	
28	**DRR Features**	
28.1	• Interactive DRR calculation mode must be available.	
28.2	• Automatic window width/level selection for DRR.	
28.3	• DRR should be interactively updated when the isocenter position is modified.	
28.4	• Should be possible to highlight or suppress different density region in the DRR.	
28.5	• Printing of DRR images should be possible. DRR should be user defined.	
28.6	• Marco function to save a series of frequently used steps should be available.	
28.7	• Specify DRR image enhancement tools to improve DRR image quality.	
28.8	• Reconstruction of DRRs should be real-time or in sub-seconds.	
28.9	• Direct printing of DRR on laser film should be possible.	
28.10	• Real time display of DRR as beam parameters changes.	
29	**Depth Control**	
29.1	• System should support depth control mode creating a DRR from slab of 3-D mode, perpendicular to beam axis.	
29.2	• DRR must be calculated over a user-defined thickness.	
29.3	• Depth control in oblique projections must be possible.	
29.4	• Should be possible to merge two DRR image on the same beam.	
29.5	• Cross-hair display on DRR to provide scale information	
30	**Measurement Package**	
30.1	• The software should provide the density value (in Hounsfield unit) of a particular point on an image. It should compute distance along straight lines and curved lines, angles between the lines, and radius of curvature for curves.	
30.2	• For a specified region of interest, ROI, the area, minimum and maximum voxel values, mean and standard distribution and a density histogram should be available.	
30.3	• The software should be able to calculate the volume of a displayed 3-D object.	

31	**Training**	
31.1	• The vendor should provide comprehensive training by application specialist for the CT Simulator at the site on installation and to the full satisfaction of the Department of Radiotherapy. The training period should be at least for four weeks or more.	
31.2	• Training in a well-advanced centre for two Radiation Oncologists, Two Medical Physicists and two radiotherapy technicians for at least two weeks.	
31.3	• Factory training for 2 clinical engineers in 2 levels at least	
32	**Power Supply**	
32.1	• Should work on three Phase 380-440 V / 50 Hz Power. And all the electrical wireing for the room and the console must be done by the bidder (including the room and console light).	
32.2	• On line UPS with MF batteries with rack for the backup of the entire system (i.e. for the complete system including Gantry, computer system, anesthesia delivery system, monitor and defibrillators, Broadband connectivity in console, power panel in the electrical room including power cable approx. 100 RM (as per requirement) from the Transformer to the electrical room of the equipment) for at least thirty minutes.	
32.3	• Reset-table over-current breaker shall be fitted for protection.	
33	**General Conditions**	
33.1	• The supplier shall give a comprehensive warranty for five years after installation and handing over of the system including local items (and battery replacements).	
33.2	• The company must support 15 years life span of the supplied machine along with software, spare parts and supplied accessories.	
33.3	• The supplier should provide comprehensive maintenance contract inclusive of customs and all taxes for the next five years (i.e. years 6 to 10).	
33.4	• Uptime Warranty: 95% uptime warranty should be provided. In case the equipment is down beyond the 95% uptime.	
34	**Certificate**	
34.1	• CE	
34.2	• ISO 13485	