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TECHNICAL SPECIFICATIONS FOR PURCHASE OF CT SIMULATOR FOR DEPARTMENT OF RADIOTHERAPY

1. MANDATORY REQUIREMENTS
1.1. The quoted model should have FDA approval.
1.2. In addition, the quoted model should be type approved by AERB.
1.3. FDA certificate & AERB Type Approval Certificate should be enclosed with the technical bid.
2. GENERAL REQUIREMENTS
2.1. The quoted model should be a dedicated CT-Simulator which is required for Radiotherapy Department for conventional, 3-D CRT, IMRT, IGRT, 4-D IGRT (SYMMETRY) of ELEKTA SYNERGY, VMAT planning and upgradable for Stereotactic Radiotherapy planning. The CT-Simulator should be able to be used for most accurate simulation, placement of treatment fields and marking of radiation field portals on patients' skin for radiation therapy of cancer.
2.2 The quoted model should be the latest, state-of-the-art model.
2.3. The CT scanner should be a wide-bore whole-body spiral, minimum 16-slice or more slices per rotation multi-detector technology incorporating latest technology available in the market.
2.4. The simulator software should be user-friendly, easy to use, error-free and should have total compatibility between scanner and simulator workstation. If third-party software is supplied, it will be the sole responsibility of the vendor supplying the CT-Simulator to run the software seamlessly.
2.5 The system should be able to integrate the Virtual simulation software workstation to the ONCENTRA 3-D Treatment Planning System for Brachytherapy & External Beam Treatment Planning System and MONACO Treatment Planning System for External Beam and Elekta Synergy Triple Energy Linear Accelerator and this will be entirely and direct responsibility of the CT-Simulator Vendor. Compatibility should be complete in all respects.
3. CT-SCANNER SPECIFICATION
3.1. GENERAL: The quoted model should be a whole body spiral, 16-slice or more CT (multi-detector) with flat table top and other accessories for Radiotherapy Treatment Planning and Simulation.
3.2. GANTRY
3.2.1. Gantry aperture should be adequate enough to plan all types of RT planning with patients in their actual treatment position. Hence aperture of more than 80 cm will be desirable.
3.2.2. Gantry tilt should be at least ±20 degree.
3.2.3. Scan Field of View should be 50 cm or more. State the extended Field of View, if available.
3.2.4. Metal-free scannable range should be atleast 150 cm.
3.2.5. Gantry must have laser-positioning lights with a positioning accuracy of ± 1 mm or better.
3.2.6. Should be completely air-cooled gantry without the need of any external cooling system.
3.3. X-RAY GENERATOR

3.3.1. High frequency x-ray generator with power rating of at least 80 kW or more if available will be preferred.
3.4. X-RAY TUBE
3.4.1. The x-ray tube should have anode heat storage capacity of 5 MHU or more.
3.4.2. The anode peak heat dissipation rate should be 700 KHU/ min or more.
3.4.3. X-ray tube should have dual focal spot. Specify the size of the focal spots.
3.4.4. There should be atleast 3 kV settings available over a range of 80 kV to 140 kV or better.
3.4.5. The mA range must be from 10 mA to 400 mA or better, with step size of 10 mA or better.
3.5. DETECTOR SYSTEM
3.5.1. The detector system should be a high-performance, low-noise, high data density, active response data acquisition system.
3.5.2. The detectors should be solid state, preferably rare earth material. Please give details.
3.5.3. The detector system should be free from repeated calibrations.
3.5.4. The detector system should be able to acquire a minimum of 16 slices per rotation.
3.6. PATIENT COUCH
3.6.1. The couch top material must be carbon fibre with TG-66 compliance & minimum dimensions of 235 cm x 40 cm, having horizontal moving range of 170 cm or more.
3.6.2. The table should be universally flat with flat tabletop.
3.6.3. The table should be compatible with the table of High Energy Linear Accelerator.
3.6.4. The table should have patient positioning index system on carbon fibre tabletop.
3.6.5. The table should be able to bear weight up to 180 kg or more with positioning accuracy of ± 0.5 mm and table top should not have sagging.
3.6.6. The table should have metal free range of about 150 cm and should have scanable horizontal range of 150 cm.
3.6.7. The horizontal accuracy should be ±0.5 mm.
3.6.8. It should be possible to move the table top from the table side and control console and hand pendant.
3.6.9. The table should have auto-home facility.
3.6.10. The table should have total free floating facility.
3.6.11. All patient-positioning accessories including tilt should have control both from gantry and from control console.
3.7. CONTROL CONSOLE
3.7.1. It should have 19” or more LCD monitor for display of 1024 x 1024 matrix or more.
3.7.2. All functions viz., scanning, image reconstruction, film documentation, MPR, CT maximum intensity projection, 3D with SSD etc., should be possible from main console and workstation.

3.7.3. Image storage of 200 GB or more for at least 100,000 images in 512 x 512 matrices uncompressed or better. The latest configuration may be quoted.
3.7.4. Latest fast DVD R/RW facility for archiving must be available.
3.7.5. The image reconstruction time should be less than 1.5 second from any mode.
3.8. CT-SCANNING PARAMETERS
3.8.1. The slice thickness should be user-selectable from 0.625 mm to 10 mm.
3.8.2. kV range: 80 to 140 kV
3.8.3. mA range: 10 to 400 mA in increment of 10 mA or better.
3.8.4. Scan time for full 360 degree rotation should be 0.5 second or less.
3.8.5. Scan field view should be 50 cm or more.
3.8.6. Display field of view should be 50 cm or more.
3.8.7. Intra-Plan delay of 5 seconds or less should be possible
3.8.8. Retrospective reconstruction should be possible on raw data files with change in parameter such as FOV
3.8.9. The following scanning modes should be possible:
3.8.9.1. Scanogram
3.8.9.2. Axial
3.8.9.3. Spiral
3.8.9.4. It should be possible to mix spiral and axial modes. Specify how many modes can be mixed.
3.8.10. It must be possible to obtain the scanogram for AP or PA or left-to-right or right-to-left directions.
3.8.11. The accuracy of slice prescription from scanogram should be ±0.5 mm or better.
3.8.12. Pilot Scan: The pilot scan field size should be more than 1000 mm long and 500 mm wide. The reconstruction time for pilot scan should be 3 seconds for a 512 matrix and 5 second for matrix of large size.
3.8.13. Reference scan should be possible on an arbitrary slice within the proposed treatment volume.
3.9. IMAGE QUALITY
3.9.1. The reconstruction matrix must be 512 x 512 or higher.
3.9.2. The reconstruction time should be as less as possible. Specify the reconstruction time.
3.9.3. Simultaneous scanning and reconstruction should be possible. It should be possible to do:
3.9.3.1. Simultaneous scanning & routing analysis
3.9.3.2. Simultaneous scanning & archiving and/or hard copying, and

3.9.3.3. Simultaneous scanning and transfer to second console / workstation.
3.9.4. 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.
3.9.5. High contrast Spatial Resolution: It should be 15 lp/cm maximum at 0% MTF for a slice of 1 cm thickness. Clearly specify the phantom used, scan time, mA, filter for image reconstruction, scan field, dose and MTF.
3.9.6. Low contrast detectability 5 mm or less at 0.35% with 10 mm slice thickness on CATPHAN phantom.
3.9.7. The CT number accuracy must be better than ± 4 HU for water and ± 10HU for air.
3.9.8. All necessary phantoms to check the spatial resolution of the scanner should be provided.
3.9.9. A special phantom to check the electron density-HU relationship for different body tissues must be provided.
3.9.10. Spiral parameters: Different selection of pitch should be possible, from 0.5 to 3 in 0.1 increments.
3.9.11. Interscan delay in different group of spiral should not be more than 5 seconds.
3.10. **COMPUTER SYSTEM OF CT-SCANNER**
3.10.1. A very high-end main computer system, latest available in the market must be provided. The system must have two processors (parallel).
3.10.2. RAM size must be at least 4 GB or better.
3.10.3. There must be two monitors in the console and they must be 19-inch or more TFT flat screen LCD monitors. One of this will be used for acquisition and other will be used for review and processing.
3.10.4. The hard disk capacity of the main computer system must be at least 275 GB or more.
3.10.5. 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 or more. The maximum possible hard disk capacity must be provided.
3.10.6. For archiving, either DVD writer should be provided. The images should be able to convert to JPEG/MEPG to be recorded on to recordable CD and DVD.
3.10.7. Please supply 500 re-writable DVDs.
3.10.8. The CT simulator system should be fully DICOM compliant. The DICOM should support the following:
3.10.8.1. DICOM 3.0 or higher Print and service class as a user
3.10.8.2. DICOM 3.0 Storage class as a user.
3.10.8.3. DICOM 3.0 Storage class as a provider.
3.10.8.4. DICOM 3.0 Send/Receive.
3.10.8.5. DICOM 3.0 Query/Retrieve service class as a user.
3.10.8.6. DICOM 3.0 Query/Retrieve service class as a provider.
3.10.9. DICOM compliance statement must be provided.
3.10.10. A bidirectional speaker communication must be provided between the operator and the patient.
3.11. STANDARD SOFTWARES

3.11.1. Complete scanning and evaluation software.
3.11.2. 3-D surface shaded and 3-D volume rendering.
3.11.3. Quantitative CT measurement tools should be provided.
3.11.4. 3-D small volume analysis software for solitary nodules is desirable.
3.12. ESSENTIAL ACCESSORIES
3.12.1. Lead glass: 60 cm x 120 cm or more with 2 mm lead equivalence to meet the AERB radiation safety requirements.
3.12.2. Laser film printer: A laser film printer (networked) should be provided. Remove filming should be possible.
3.12.3. Pressure injector should be supplied along with 500 reusable syringes.
3.12.4. Voltage stabilizer: Servo voltage stabilizer for whole unit including accessories.
4. LASER SYSTEM (Moving lasers)
4.1. The CT Simulator should have atleast 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. 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.
5. CT-SIMULATION WORKSTATION
5.1. GENERAL
5.1.1. One CT simulation workstation must be provided.
5.1.2. The workstation should have advanced CT simulation tools for radiation therapy treatment planning compatible with the ELEKTA LINAC.
5.1.3. All necessary calibration/QA phantoms/check devices should be provided. Please specify the kits above.
5.1.4. The workstation should be able to provide complete volume definition and geometric beam placement for radiotherapy.
5.1.5. It should have complete compatibility and error-free DICOM networking with a CT scanner computer and with all TPSs. All licenses required should be permanent and included in the offer.
5.1.6. The CT simulation should generate digitally reconstructed radiographs (DRRs) in a true volumetric environment.
5.1.7. It should be possible to overlay the beams on any DRRs or on any slice (obtained and reconstructed).
5.1.8. It should be possible to load over 250 CT images per patient for reconstruction and simulation.
5.1.9. Visualization of beam entry on patients' skin should be possible.
5.1.10. SSD calculation should be available.
5.1.11. Facility to display BEV on a MPR (including oblique MPR) with fields and blocks displayed divergently.
5.1.12. Automatic conforming to treatment fields and blocks.

5.2. HARDWARE
5.2.1. Hardware specification should be mentioned clearly.
5.2.2. The system should be running on a high-end workstation platform of reputed brand like Sun Microsystems/HP workstation/Dell/Silicon Graphics with at least 2 GB RAM or more. Minimum 128 bits processor with minimum of 120 GB hard disk or more.
5.2.3. The user interface should be windows based and menu driven.
5.2.4. Display should be on a 19" (or more) high-resolution color LCD monitor with a high resolution of 1024 x 1024 pixels or better.
5.2.5. A compatible 56 Kb internal/external modem should be provided for remote diagnostics and upgrades.
5.2.6. The latest archiving media should be provided. Provide details.
5.2.7. Networking with TPS: All the software with licences required should be included. Complete DICOM-RT export/import license should be available.
5.2.8. Laser printer should be provided.
5.2.9. It should be possible to take printouts on this printer from any of the CT simulation workstation.
5.3. SOFTWARE
5.3.1. Complete software doing all the functions of CT simulator as per the ELEKTA SYNERGY specifications (IMRT,IGRT,4D-IGRT,VMAT) and should have following features:
5.3.1.1. Software should be windows based system.
5.3.1.2. Software should have a volume accelerator for high speed 3-D rendering at full spatial resolution.
5.3.1.3. On the monitor screen it should be possible to view at least 16 images or more.
5.3.1.4. 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.
5.3.1.5. 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.
5.3.1.6. It should be possible to simulate all kinds of teletherapy machines in the simulation workstation. It should conform to IEC and other international standards for linear accelerator conventions.
5.3.1.7. It should be possible to visualize interactively reference views in axial, coronal, sagittal, isocenter image planes in any oblique directions with overlay of beams on DRRs.
5.3.1.8. DRR must provide fully divergent beam's eye view of 512 x 512 matrix.
5.3.1.9. The DRR/BEV and Room Eye View should display the machine diagram to allow real time checking of machine and patient geometry.
5.3.1.10. Facility for multimodality fusion to accept data from other DICOM compatible and DICOM supporting modalities like MRI/CT/PET/SPECT and should be able to fuse them.
5.3.2. Support for asymmetric collimators and multileaf collimators (MLCs).
5.3.3 Anti Virus software for entire network with time to time upgradation if CT & Workstations are MS windows based systems.
5.4. CONTOURING

5.4.1. Volume definition should be possible using volume segmentation using threshold, free hand contour tracing, contour editing, 3-D anisotropic margins, etc., and any other advanced tools.
5.4.2. System must be able to contour in axial, sagittal, coronal, and oblique projections.
5.4.3. It should be possible to do manual, semi-automated, fully automated contouring /segmentation in the images by defining volume of interest. Auto Segmentation of organs such as liver, eye, lungs, spinal cord etc should be standard.
5.4.4. Mention the time taken for automatic contouring with a single mouse operation for 50 slices.
5.4.5. The software should have facility for automated uniform or non-uniform margins. For example it should be possible to expand the clinical target volume (CTV) on all three dimensions by same magnitude or by different magnitudes to define planning target volume (PTV). Any software without this automated uniform/nonuniform feature will be considered as inadequate.
5.4.6. It should be possible to copy one organ to another with margin ,add margins on a single slice, a range of slices or all slices.
5.4.7. It should also be possible to interactively edit the contours with user's choice of segments to reject or accept.
5.4.8. Interpolate algorithm should be available to provide interactive, shape based interpolation i.e. after contouring only in selected slices, the algorithm should automatically interpolate the closely fitting contours in other slices.
5.4.9. Interpolated contour may be edited; accepted or rejected.
5.4.10. Tracking of source to skin distance should be possible.
5.4.11. Contouring and editing and extraction of wall should be possible.
5.5. ISOCENTER MANAGEMENT
5.5.1. The software should support separate isocenters for multiple target volumes or general regions.
5.5.2. Marked and final isocenters should be reported and displayed in the localization package for easy confirmation of a physical simulation session.
5.5.3. Hard copy of the isocenter coordinates should be possible for record of the simulation session.
5.5.4. Isocenter positioning should be automatic.
5.5.5. No limit on number of isocenters per target.
5.6. 3-D VIEW AND VOLUME RENDERING CAPABILITIES
5.6.1. Post-processing features like Volume Rendering, Real-time multi-axial volume reconstruction, 3-D surface rendering, color 3-D should be available.
5.6.2. It should allow complete 3-D volume to be defined including complex 3-D volumes, user selectable multi-image views, BEV, DRR, etc.
5.6.3. DICOM-RT plans and data structure set with import/export of data should be possible. The DICOM compliance statement should be provided.
5.6.4. Accuracy of locating any point in 3-D should be 0.1 mm or less.
5.7. BEAM PLACEMENT & DEFINITION
5.7.1. It should support extensive beam shapers (shielding blocks etc.) and beam definition methods.
5.7.2. Manual or automatic beam placement tool.

5.7.3. Tools for Real-time checking of machine geometry should be there.
5.7.4. Beam shaping should be possible in multiple ways like automatic shielding block definition conforming to selected volume, definition as aperture or shielding, manual free hand definition, automatic collimator jaw or multileaf position definition, etc.
5.7.5. 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.
5.8. DRR FEATURES
5.8.1. Interactive DRR calculation mode must be available.
5.8.2. Automatic window width/level selection for DRR.
5.8.3. DRR should be interactively updated when the isocenter position is modified.
5.8.4. It should be possible to highlight or suppress different density regions in the DRR.
5.8.5. Printing of DRR images should be possible.
5.8.6. DRR presets should be user defined.
5.8.7. Macro-function to save a series of frequently used steps should be available.
5.8.8. Specify DRR image enhancement tools to improve DRR image quality.
5.8.9. Reconstruction of DRRs should be Real-time or in sub-seconds.
5.8.10. Direct printing of DRR on laser film should be possible (remote printing).
5.8.11. Real time display of DRR as beam parameters are changed.
5.9. DEPTH CONTROL
5.9.1. The system should support depth control mode creating a DRR from slab of 3-D mode, perpendicular to beam axis.
5.9.2. DRR must be calculated over a user defined thickness.
5.9.3. Depth control in oblique projections must be possible.
5.9.4. It should be possible to merge two DRR images on the same beam.
5.9.5. Cross-hair display on DRR to provide scale information should be available.
5.10. DATA IMPORT / EXPORT
5.10.1. System should be able to export image, volume and plan data in DICOM 3.0 standard along with all radiotherapy specific data and private objects, DICOM-RT plans and data sets.
5.10.2. System should be able to import DICOM-RT data to the linear accelerator of any vendor.
5.10.3. The CT simulation system should be fully integrated with the existing TPSs in the department. The vendor should inspect and will be responsible for complete integration.
5.10.4. All import and export licenses should be provided.

5.10.5. It should be possible to rotate 3-D models on the screen and export the display output as an AVI file on the CD so that it can be viewed on any PC.
5.10.6. The entire CT simulation system must be interconnected (all the workstations, laser system, printers, etc.) and must be integrated into the linear accelerator systems and brachytherapy system for smooth transferring of images and DICOM-RT structures.
5.11. DOCUMENTATION & ARCHIVING
5.11.1.Should be on a color dye sublimation or alternative.
5.11.2. Suitable and economic printer to be supplied along with the system.
5.11.3. DICOM print should be possible.
5.11.4. Adobe Post Script printing should be available.
5.11.5. Archiving should be on DVD in DICOM format.
5.12. MEASUREMENT PACKAGE
5.12.1. 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, angle between the lines, and radius of curvature for curves.
5.12.2. For specific region of interest (ROI) the area, minimum and maximum voxel values, mean and standard distribution and a density histogram should be available.
5.12.3. The software should be able to calculate the volume of a displayed 3-D object.
5.13. IMAGE MANIPULATION
5.13.1. Different kinds of image manipulation features should be available like multiplanar reconstruction and curved reformatting.
5.13.2. 3-D reconstruction with no waiting for reprocessing.
6. ENVIRONMENTAL FACTORS
6.1. Complete installation should include:
6.1.1. Room planning and designing as per AERB guidelines and approval.
6.1.2. Air conditioning and monitoring of temperature and relative humidity and air changes (to specify number per hour) to be installed by the vendor.
6.1.3. The unit shall be capable of being stored continuously in ambient temperature of 0 to 50 degree Celsius and relative humidity of 15 to 90%.
6.1.4. The unit shall be capable of operating in ambient temperature of 20 to 30 degree Celsius and relative humidity of less than 70%.
6.2. The unit shall meet IEC-60601-1-2:2001 (or equivalent BIS) General Requirements Of Safety For Electromagnetic Compatibility or should comply with 89/366/EEC;EMC-directive.
7. POWER SUPPLY
7.1. Should work on three phase 200 to 220 volts/50 Hertz Power.
7.2. Online UPS of suitable rating should be supplied for the complete system including gantry, computer system, anesthesia delivery system, monitor and defibrillators with at least 30 minutes back up. Please specify the make and model of the UPS.
7.3. Reset-table over-current breaker shall be fitted for protection.

8. ACCESSORIES & DOCUMENTS
8.1. Two numbers of Complete User/Technical/Maintenance manuals to be supplied in English (Soft copy & Hard copy). The manual should indicate complete functional and circuit diagram.
8.2. Certificate of calibration and inspection from factory.
8.3. List of equipment available for providing calibration and routine preventive maintenance support as per manufacturer documentation in service/technical manual.
8.4. List of important spare parts and accessories with their part number and cost should be provided.
8.5 The system should have the warranty / guarantee for three years including Tube and other accessories from the date of commissioning or equipment is ready for clinical use. 8.6 CMC should be quoted for 5 years after warranty period is over which should include equipment and all other accessories supplied with the equipment including CT tube.
8.7 Compliance Report to be submitted in a tabulated and point wise manner clearly mentioning the page/Para number of original catalogue/data sheet. Any point, if not substantiated with authenticated catalogue/manual, will not be considered.
8.8. Quote only from Manufactures or Authorized Single All India dealers will be accepted. Franchise dealer state/region wise will not be entertained as their continued support has not proven reliable in our earlier procurement.
8.9. Demonstration of the quoted model should be conducted at the consignee site before installation of the equipment.
9. TRAINING
9.1. The vendor should provide comprehensive training by application specialist for the CT simulator at the site on installation and to full satisfaction of the Head, Department of Radiotherapy. The training period should be atleast for four weeks. The institution reserves the right to split this four-week training in phases for optimal learning and usage of the unit.
9.2. One week training at a reputed center where similar mode is used within the country for two Oncologists, two Medical Physicists and one Technologist.