

Technical Specification for a CT-Simulator

Sealed tenders (Sealed separately as the "Technical Bid & the Price Bid-in duplicate) are invited directly from the manufacturers/principles for the supply of state-of the-art and latest technology based CT-Simulator. The CT-simulator includes CT scanner, laser system and virtual simulation system. The CT scanner should be of **spiral multislice, large-bore atleast 20 slices per rotation** model which should be capable of 4DCT acquisition. It should also be capable of integrating with standard networking and PACS systems available in the hospital. The offered equipments should have the following technical features.

1. CT Scanner system

- 1.1 The system should be of latest slip-ring technology allowing acquisition of 20 slices per rotation with true isotropic volume acquisition and sub millimeter resolution of an at least 0.4mm.

2. X-ray Generator

- 2.1 High frequency x-ray generator with an output of at least 50 KW or more to support continous and sustained operation. Please give details.

3. X-ray Tube

- 3.1 Tube current: 30-500mA or more. The mA rating at peak generator power must be mention.
- 3.2 The system should have mechanism for real time mA modulation for both Z axis and angular dose modulation
- 3.3 Tube voltage should be in the range of 80-140kV
- 3.4 The x-ray tube should have anode heat storage capacity of 6 MHU or more.
- 3.5 The anode peak heat dissipation rate should be 1000 KHU/min or more angular dose modulation.
- 3.6 The x-ray tube should have dual focal spot (please specify the size of each focal spot). The automatic selection of focal spot should be possible.
- 3.7 Filter and beam limiting device: Their Al equivalent (at least 5mm) and other specific features to reduce radiation dose to the patient must be specified.

4. Gantry

- 4.1 Gantry aperture should be minimum 80 cm or more
- 4.2 Entire range of rotation times for full 360 degree should be specified.
- 4.3 Remote controlled tilt from operator table should be possible.
- 4.4 Laser alignment lights should define accurately actual scan of plane. It should operate over full range of gantry tilt.
- 4.5 Green laser patient alignment system with (gantry and external wall /ceiling mounted) stationary and mobile for radiotherapy planning should be provided.

5. Patient Table

- 5.1 The scanning table should be universally flat with flat table top and should be compatible with tables of linear accelerators installed. The table should have patient positioning index system on carbon fiber table top.
- 5.2 The table should be able to bear weight up to 200 Kg or more.
- 5.3 Table should have the metal free scanable range should be at least 150 cm.
- 5.4 Horizontal accuracy should be ± 0.50 mm or less
- 5.5 Vertical table travel range should be specified. Minimum at least 55cm height.
- 5.6 Table should support the immobilization accessories for conformal and stereotactic procedures. QA phantom holder, water level phantom and laser calibration bar should be provided.
- 5.7 The table should have total free floating facility
- 5.8 All patients positioning accessories including tilt should have control both from gantry and control console

6. CT scanning parameters

- 6.1 The slice thickness should be users selectable which range from 1 mm to 10 mm.
- 6.2 Minimum scan time for full 360 degree rotation should be 0.5 seconds or less for whole body applications.
- 6.3 Maximum true scan field of view should be at least 60 cm or more
- 6.4 Extended reconstruction FOV of at least 70cm should be possible.
- 6.5 Gapless spiral length should be 150cm or more.
- 6.6 Specify single continuous spiral-on-time should be minimum 100 seconds or more.
- 6.7 The system should automatically optimize radiation dose and resolution for each selection.
- 6.8 Bolus triggered spiral acquisition should be possible. Give detail of sub millimeter resolution.
- 6.9 Both spiral and sequential mode acquisition should be possible for all scanning protocols.
- 6.10 Prospective and Retrospective respiratory compensated/gated CT to generate 4D datasets must be compatible with all commercially available hardware and software for motion management to localize the tumor in motion. Specify the details.

7. Scannograms/Topogram

- 7.1 Length and width: specify the range
- 7.2 Scan times: specify the range
- 7.3 Views: should be feasible in frontal and lateral views
- 7.4 Should be possible to interrupt acquisition manually once the desired anatomy is obtained.

8. Data Acquisition system

- 8.1 Detector: Please specify the number of detectors, detector design and type of detector.
- 8.2 Number of rows with their thickness, number of elements in each row
- 8.3 Mention the channels per row and number of projections
- 8.4 In-built mechanism for adapting the tube current during each scan. This should enable radiation dose reduction where body part thickness is less. Specify the mechanism used in the offered system.
- 8.5 There should be in-built pediatric protocols adapted to weight and/or age.
- 8.6 Specify available mechanisms to reduce the effective patient dose.

8.7 Vendor should provide the 4DCT acquisition system as applicable to the offered system.

9. Image Reconstruction

- 9.1 Real-time reconstruction speed: 10 images per second or more at 512x512 matrixes.
- 9.2 Display matrix should be minimum 1024 x 1024 or more.
- 9.3 Freely selectable window width and centre with organ specific preset windows be possible
- 9.4 Retrospective reconstruction with variable slice thickness should be possible.

10. Image Quality

- 10.1 High Contrast Spatial Resolution: It should be 15 lines pair per cm or better (for 60 cm FOV) 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.
- 10.2 Low Contrast Detectability: The low contrast resolution for CATPHAN should be at least 5mm or less at 0.3% using 20cm CATPHAN phantom on 10mm slice thickness.
- 10.3 Spiral parameters: Different selection of pitch should be possible, from 0.5 to 3 in 0.1 increments. Inter scan delay in different group of spiral should not be more than 5 seconds.
- 10.4 CT number accuracy must be better than ± 4 HU for water and ± 10 HU for air. All necessary phantoms to check the spatial resolution of the scanner should be provided. A phantom to check the electron density to HU relationship for different body tissues must be provided.

11. CT Control Console

- 11.1 It should have 24" or more TFT flat screen LCD colour monitor for display of 1024 x 1024 matrix or more.
- 11.2 Computer CPU systems should be running on a high-end workstation platform with UNIX/Window of latest configuration. RAM size must be atleast 8GB or better.
- 11.3 All functions viz. registration, scheduling, scanning, image reconstruction, image evaluation tools, post processing tools, film documentation and transfer of images, MPR, CT, maximum intensity projection, 3D with SSD etc should be possible from main console and workstation
- 11.4 Image storage of 2TB or more for at least 2, 50,000 or more images in 512 x 512 matrixes uncompressed or better (quote the latest configuration)
- 11.5 At least one high resolution medical grade laser color printer with latest model should be provided.
- 11.6 CD/DVD facility for archiving must be available.
- 11.7 The image reconstruction time should be less than 1.5 second for any mode.
- 11.8 An on-line juke-box with total storage capacity of 1.5 Terra bytes with fully loaded media for data storage should be provided.
- 11.9 The system should have fully DICOM complaint. DICOM compliance statement should be provided.
- 11.10 An integrated intercom for bi-directional speaker communication between operator and patient and also automated patient instruction (API) system should be provided.

12. Laser System

- 12.1 The CT-Simulator laser systems should have at least **three computer controlled moving lasers** for marking the isocenter without moving the table top. Following the isocenter localization in the CT-Simulation workstation, the isocenter coordinate will be sent directly to the computer system that is controlling the movements of the lasers. This computer in turn should drive all the lasers, so that without moving table, the laser point to the isocenter. The laser must be GREEN LASER system. Complete quality assurance tools must be provided.
- 12.2 In addition to the moving laser, the CT -Scanner should have conventional in-built lasers for positioning the patient.
- 12.3 The vendor should give a complete description about the laser marking system offered and how the CT-Simulation software integrates with it.

13. CT-Simulation/Virtual Simulation System

- 13.1 The CT-Simulation/Virtual Simulation System should be possible to simulate all kinds of teletherapy machines in the simulation workstations without any kind of restrictions. It should support IEC, Varian, Elekta and other user defined linear accelerator conventions.
- 13.2 It should be possible to visualize interactively reference views in axial, coronal, sagittal, isocenter image planes and in any oblique direction with overlay of beams on digitally reconstructed radiograph (DRR).
- 13.3 DRR must provide fully divergent beam's eye view (BEV) 512x512 images.
- 13.4 The DRR and BEV/Room-eye view image should display the machine diagram to allow real-time checking of machine and patient geometry.
- 13.5 The system should be possible to support and define the asymmetric features in the Simulation software.
- 13.6 The system should be possible to support and define the multileaf collimator placement of 40 or more pairs of MLC leaves in the simulation software.
- 13.7 Three CT simulation workstation must be provided in addition to the CT workstation.
- 13.8 System should incorporate CT, MRI, PET and SPECT into localization, image fusion and registration

14. Contouring

- 14.1 Volume definition should be possible using volume segmentation using threshold, free hand contour tracing, contour editing, 3D anisotropic margins etc and any other advanced tools
- 14.2 System must be able to contour in axial, sagittal, coronal and oblique projections.
- 14.3 It should be possible to do manual, semi-automated, fully-automated contouring in the images by defining volume of interest.
- 14.4 The software should have facility for automated uniform/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 magnitude to define the planning target volume (PTV).
- 14.5 It should be possible to copy one organ to another with margin, and margins on a single slice, a range of slice or all slices.
- 14.6 Interpolate algorithm should be available to provide interactive, shape and interpolation i.e. after contouring only in selected slices. The algorithm should automatically interpolate the closely fitting contour in other slices. Interpolated contour may be edited; accepted or rejected.

- 14.7 Tracking of source to skin distance and contouring/extracting of wall should be possible
- 14.8 System should have the capability of 3D viewing and volume rendering should be possible.
- 14.9 The software should provide the density value (in Hounsfield Unit) of a particular point on an image. It should compute distances along straight line and curved line, angles between lines, and radius of the curvatures for curves.
- 14.10 Any other advanced features which may be of standard or optional, should be specified.

15. Isocenter Management

- 15.1 The software should support separate isocenters for multiple target volumes or general regions
- 15.2 Marked and final isocenters should be reported and displayed in the localization package for easy confirmation of a physical simulation session.
- 15.3 Hardcopy of the isocenter coordination should be possible for record of the simulation.
- 15.4 Isocenter positioning should be automatic.
- 15.5 No limit on number of isocenters per target.

16. Beam Placement and Definition

- 16.1 It should support extensive beam shapers (shielding blocks etc) and beam definition methods.
- 16.2 Manual or automatic beam placement tool.
- 16.3 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 or multi leaf position definition.
- 16.4 It should be possible to define this asymmetric collimator feature, where both the X and Y axis are asymmetric, in the CT simulation software. Similarly the software should allow multi-leaf-collimator placement up to 40 pairs or more.

17. DRR Features

- 17.1 Interactive DRR calculation mode must be available.
- 17.2 Automatic window width/level selection for DRR.
- 17.3 DRR should be interactively updated when the isocenter position is modified.
- 17.4 Should be possible to highlight or suppress different density region in the DRR.
- 17.5 Printing of DRR images should be possible. DRR presets should be user defined.
- 17.6 Reconstruction of DRRs should be real-time or sub-second.
- 17.7 Real-time display of DRR as beam parameter changed should be possible.
- 17.8 Differential tissue weighting in DRR calculation should be possible.
- 17.9 Facility to display BEV on MPR with fields and blocks displayed divergently.
- 17.10 Any other advanced features available should be specified.

18. Data Import/Export and Connectivity

- 18.1 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.

- 18.2 System should be able to import DICOM RT data to the linear accelerator of any vendor.
- 18.3 CT simulator system should be fully integrated with the existing TPS. The vendor should inspect and will be responsible for complete integration.
- 18.4 Specify clearly the DICOM-RT import and export licenses that are being offered.
- 18.5 The entire CT-Simulation system must be interconnected (all the workstations, laser systems, printers, etc) must be integrated to treatment machines available in the department for smooth transferring of images and DICOM-RT structures.

19. Archiving and Documentation

- 19.1 Should be on a Color dye sublimation printer to be supplied along with system. DICOM print should be possible.
- 19.2 Adobe PostScript Printing should be possible.
- 19.3 Archiving should be on a CD in DICOM format.
- 19.4 User / Technical / Maintenance manuals to be supplied in English.
- 19.5 Certificate of calibration and inspection
- 19.6 List of Equipments available for providing calibration and routine preventive maintenance support as per manufacturer documentation in service / technical manual.
- 19.7 List of important spare parts and accessories with their part number and costing.
- 19.8 Log book with instruction for daily, weekly, monthly and quarterly maintenance checklist.

20. Equipment Warranty and Service Facilities

- 20.1 Five years warranty to be commenced from first patient treated as per AERB norms.
- 20.2 CMC year-wise for quoted machine, UPS, Battery and other accessories for next 5 years after warranty period.
- 20.3 98% uptime warranty/guarantee during warranty and CMC period.
- 20.4 Spare parts should be available for minimum of 10 years.
- 20.5 During the warranty period, all the software updates and upgradation should be provided without asking for free of charge.
- 20.6 Please quote the rates of consumables recommended as well as other necessary consumables valid for 5 years block
- 20.7 Factory trained service engineer/Applications specialists should be available in Delhi to look after the installation and maintenance of the system without patient treatment interruption.

21. Standards, Safety and Training

- 21.1 Equipment standard and safety should comply with the national regulatory AERB guidelines and offered model should have AERB type approval and NOC.
- 21.2 Should be USA-FDA and/or European CE certified product.
- 21.3 The vendor should provide comprehensive training on CT-Simulator in a well advanced center in any developed country for two persons (one for Radiation Oncologist, one for Medical Physicist).The training period should be at least for two weeks.

- 21.4 On-site Application training should be provided for minimum two weeks for all staff members in the department.

22. General Terms & Condition

- 22.1 Any optional items to be quoted separately with separate prices in price bid.
22.2 The vendor shall list the number of their CT-Simulator installation/user in India.
22.3 All claims regarding meeting the specification should be duly supported by appropriate, latest technical catalogues/brochures from the manufacturer.
22.4 Penalty clause: Penalty at the rate of RS.10, 000 per day for short falling of 95% uptime guarantee. If the machine lies non-functional for a period of more than two weeks continuously, the same penalty will be imposed even if 95% uptime clause is met with.

Scope of the Trunking work for bunker

General Requirements

1. The Supplier should inspect the proposed site offered by the Consignee, wherein the CT-Simulator system has to be installed. They are required to submit the plan for the project. The scope of work includes complete Electrical, Wall finishing, Air-conditioning, Flooring for the proper functioning of the CT-Simulator system. The supplier shall assist the user by providing necessary documentations/technical data for regulatory clearances and approvals from AERB.
2. The cost of the site modification work should be quoted separately and this cost will be considered for L1 calculation.
3. Vendor will have to quote Unit Rates of the following components of Site work.
 - i. Electrical work
 - ii. Air conditioning (HVAC)
 - iii. Flooring
 - iv. Wall Finishing & Painting
 - v. False Ceiling
4. The payment for site modification work shall be based on the Unit Price quoted by the supplier applied to the actual measurement of Site work executed at the supplier at the site.
5. Bidder should clearly mention break up price of each component of Site work separately.
6. The system should be installed and handed over in working condition with all necessary electrical, wall finishing, air conditioning, flooring and plumbing work undertaken by the vendor in consultation with the user dept.

7. Rate quoted for Site work, Furniture like desks, chairs, shelves etc; and the price quoted for 7 TR HVAC is included for L1 calculation of the bids.
8. The CT-Simulator system facility shall consist of the following rooms:
 - a. CT-Simulator system room
 - b. CT-Simulator system console room
9. The supplier shall be required to specify the total load requirements for the CT-Simulator system including the load of air conditioning, room lighting and for the accessories if any. The supply line will be provided by the Institute up to one point within the CT-Simulator facility. The mains panel and distribution panel for CT-Simulator system, HVAC, and LIGHTING should be provided by the supplier. Few lights in HDR brachytherapy system, treatment room with console area, UPS ROOM shall be connected to the UPS to provide emergency lighting.
10. The bidder may quote the unit rates of any other site work activity which is not mentioned in the list below.

THE ELECTRICAL WORKS:

1. Wiring – All interior electrical wiring with main distribution panel board, necessary MCBs, DB, joint box, switch box etc. the wires shall be of copper of different capacity as per the load and should be renowned make as listed below.
2. All necessary cabling like LAN, DICOM & PACS for data interface between TPS and Linear accelerator system, HDR brachytherapy system; system should be provided with adequate number of terminals.
3. All the internal wiring including that of telephone, LAN, DICOM & PACS etc) will be concealed variety.
4. Earthing: Double-Earthing shall be provided with copper plate for the HDR brachytherapy system and all accessories like UPS. The earthing for the AC should also be done by the suppliers. The earthing cable/wire shall be routed end-to-end through an insulated conduit.
5. Switches light and power points should be of modular type and of standard make as listed below.
6. General lights – Ceiling mounted LED lighting panels, recessed 600 x 600mm, should be provided. Light dimming facility should be provided wherever it is necessary.
7. All wires used must be FRLS (Fire Retardant with low smoke) type only.

AIR CONDITIONING WORKS:

1. The area marked for site work needs to be air-conditioned. Package Air Conditioners may be used according to room requirement and suitability. Humidity control should be provided to effectively eliminate moisture condensation on the equipment. The Air conditioning system should be designed with standby unit(s) to provide uniform air-conditioning 24 x 7.

2. The outdoor units of AC should have grill coverings to prevent theft and damage.
4. Stand-alone room Dehumidifiers of adequate capacity for CT-Simulator system room, Console room to be provided to ensure condensation-free atmosphere for the high value equipment.
5. **Environment specifications:**
Humidity range: Relative humidity 60% and 80% in all areas except equipment room which shall be as per requirement of the equipment.
Temperature ranges: $22 \pm 2^{\circ}$ C in all areas throughout the year, except equipment room which shall be as per requirement of the equipment.
6. **Air conditioning load:** The heat load calculations and maintaining the desired temperature and humidity shall be the responsibility of the supplier.

FLOORING WORKs:

1. "600x600 mm vitrified tiles with 100mm matching tile skirting in and CT-Simulator system room & Console room.
Note: Providing and laying approved quality, colour, design and shade fully homogeneous 600 x 600 mm (thickness to be specified by the manufacturer)Vitrified tile flooring (Marbonite or Granamite, confirming to IS code 15622 with water absorption less than 0.08%) flooring in pattern as detailed in drawing or as directed by the institute and grouted with matching colour approved quality readymade grout, curing, cleaning etc to required line level etc. all complete at all leads, lifts and heights to the entire satisfaction of the institute. Providing and fixing 2-3mm thick POP protection over polythene covering sheet to flooring areas till handed over and cleaning, etc all complete as per drawings & specification.
2. Floor leveling if required to be done by supplier. All installation related floor modification non structural) like Turntable pit, trench etc to be done by supplier.
3. The CT-Simulator system room, treatment console room will be made rodent / pest proof.
4. Mode of measurement (finished surface area of the tiles shall be measured and paid. Rate shall be inclusive of providing and laying leveling course, PVC spacers, providing and applying epoxy grout and no additional payment shall be made for wastage.

WALL FINISHING & PAINTING

1. Two coats Plastic Emulsion Paint over 2 coats of wall putty including primer in all areas not covered by wall tiles. Colour to be approved by institute.

2. Wall Tiles-High quality density Vitrified Tiles clad on the side walls up to a uniform height of 1200mm in all rooms; except UPS & equipment rooms. Colour to be approved by institute.
Note: Providing all tools, tackles, materials, manpower for applying plastic enamel paint over
3. Coats of wall putty including primer in all areas, of approved brand and manufacture and approved shade finished with roller to wall & ceilings surfaces, in 2 coats over a coat of approved quality primer on the plastered/POP surface, POP board/Gypsum board surfaces including scaffolding, preparation of surface, sanding, light sanding, work platform, painting equipment/apparatus etc. required to complete interior grade finish etc. at all heights & levels complete as per drawings & Specifications.

FALSE CEILING

1. Acoustical tile for ceiling with light weight insulating material of high quality supported on grid or finished seamless with support above ceiling. To be finished with white paint or powder coated with white paint, if metallic. The false ceiling panels should be of reputed brands.

MISCELLANEOUS:

1. The HDR brachytherapy system room shall be provided with wall-mounted storage cupboards within CT-Simulator system room; to store: Dosimetry & QA Items, HDR brachytherapy system accessories.
2. Sufficient number of Open Racks of high Quality vendors should be provided to house the CT-Simulator QA and immobilization materials within CT-Simulator system room
3. The treatment console room shall be provided with Wall mounted storage cupboards with MDF laminate shutters; to be fixed on the wall above the workstation (approx 1800mm length; 750 mm height; 300 mm depth).

FURNITURE:

1. Revolving chairs height adjustable, medium-back with hand-rest for Control room- 10 Nos.
2. "Workstation/Tables for CT-Simulator system console room.
The CT-Simulator system console room should be provided with suitable workstations(s) of reputed brand, to accommodate the various Terminals in console room. The Workstation shall be providing with enough power sockets, LAN sockets etc. to enable smooth functioning of the CT-Simulator system."

3. Bookshelves: Four-door bookcase with glass doors, height approx 1700mm; to store manuals; CD/DVDs, spares etc-4 Nos.
4. Shoes Rack - 2 Nos.

LIST OF ITEMS AND SUGGESTED MANUFACTURERS.

A ELECTRICAL

1. **CABLES** - Gloster, Universal, Polycab
2. **WIRES** - Finolex, Havells, V-Guard, RR Kabel, Gloster, Anchor
3. **SWITCHES** - Legrand, L&T, Crabtree , Roma, MK, Crabtree
4. **DISTRIBUTION BOX**, MCB - Legrand, L&T, Siemens, Havels
5. **LIGHT FITTINGS** - Philips / Crompton / Kesselec-Schreder / Wipro.

B AIR CONDINTIONING -Daikin, Hitachi, Blue Star, Voltas

C FURNITURE -Hermen Miller, Godrej, Featherlite, Wipro

D FALSE CEILING - Armstrong, Saint Gobain, Luxalon.

AERB Approval

1. AERB Approval for Site and Facility Layout plan to be obtained by the vendor