Technical Specification of Advanced High-Energy Linear Accelerator

Sealed tenders (sealed separately as the "Technical Bid & the Price Bid-in duplicate) are invited directly from the manufacturers/principals to supply, install and maintain **one** state-of-the-art Medical Linear Accelerator for the Department of Radiation Oncology. The purpose of the Linear Accelerator (LINAC) is to provide the basic, advanced and specialized techniques of radiation therapy for cancer using megavoltage X-rays and electron beams for external beam radiotherapy (EBRT).The Linear accelerator system includes linear accelerator (LINAC), treatment planning system (TPS), oncology information system (OIS), dosimetry and quality assurance equipment and patient positioning and immobilization devices with scope of turnkey work of bunker to accommodate the equipment.

System Overview

An Advanced, state-of-the-art technology, latest model of high-energy medical linear accelerator (LINAC) having photon and electron beam radiation equipped with a multileaf collimator (MLC) and an electronic portal imaging device (EPID) and kilovoltage cone-beam CT (KV-CBCT) and other features to perform various radiation treatment techniques such as three-dimensional conformal radiotherapy (3D-CRT), intensity modulated radiation therapy (IMRT)/volumetric modulated arc therapy (VMAT), image-guided radiotherapy (IGRT), surface guided radiotherapy (SGRT), stereotactic radiosurgery and radiotherapy (SRS/SRT), stereotactic body radiotherapy (SBRT), 4D Radiotherapy (4DRT) and flattening-filter free (FFF) beam technology.

General Requirements of Equipment Safety and Standards.

1. The offered linear accelerator model shall be of FDA (USA) and CE (Europe) certified medical device.

2. The offered linear accelerator model shall be of Atomic Energy Regulatory Board (AERB) national radiation safety regulatory body type-approved equipment.

3. The offered linear accelerator model shall have all IEC compliance of LINAC in terms of co-ordinates and scales as per IEC 1217 nomenclature and standard and also adherence to international basic safety standards apply to all medical equipment that produce ionizing radiation.

4. It should be capable of integrating with standard networking and PACS systems available in the market.

5. The system shall have the following features of technical specifications:

A. Linear Accelerator System (LINAC)

S. No	Features	Technical Specification
I. Photon beam Characteristics		
1	Photon Beam Energies	The machine shall be capable of delivering three photon energies of 6, 10 and 15MVX-ray beams.
2	Flattening-Filter-Free	The machine shall be capable of delivering two photons of 6

	Beams	MV and 10MV with flattening filter free (FFF) mode.
3	Dose Rate	i) Dose Rate in conventional mode: Range from 100 to 500 MU/min or more at depth of the dose maximum for TSD 100cm for 10x10 cm^2. ii) High Dose Rate in FFF mode: Minimum of 1000 or more MU/min for 6MV and 2000MU/min or more for 10MV. iii) Dose rate in Arc mode: It shall have continuously variable dose rate. Specify the range in terms of MU/deg
4	Beam Quality-FF Beams	Specify the beam penetrative quality parameters for all offered photon beam energies with FF: i) depth of maximum dose (dmax) ii) percent depth dose at 10cm depth (D10) or iii) quality index, TPR 20,10
5	Beam Quality-FFF Beams	Specify the beam penetrative quality parameters for all offered photon beam energies with FFF : i) depth of maximum dose (dmax) ii) percent depth dose at 10cm depth (D10) iii) field intensity at 10cm depth (measurement at three points from the central axis for 10X10 cm^2 and 30x30 cm^2or above).
6	Beam Profile Beam Flatness Beam Symmetry Beam Penumbra	i) The field flatness is defined as the maximum variation from the x-ray dose delivered within the central 80%FWHM region, normalized to the dose output at beam center line. ii) The beam flatness shall be within ±3%. Specify the same. iii) The field symmetry is defined as the maximum difference between the x-ray dose delivered to any two points that are equidistant and symmetrical about the central axis and within the central 80% FWHM region, at 10cm depth. iv) The beam symmetry shall be within±2%. Specify the same for both FF and FFF beams. v) The field penumbra is defined as the width between the 20% and the 80% isodose lines measured for 10 X 10 cm^2 at depth of 10 cm at 100 cm SSD. vi) The beam penumbra shall be within 10mm. Specify the same.
7	Radiation Leakage Limit	Radiation leakage limits shall be within appropriate national and international regulatory agency guidelines as follows: i) Photon leakage: The photon leakage rate at any point one meter from the target outside the cone defined by the primary x-ray collimator shall be less than 0.1% of

		the absorbed dose at the isocenter. ii) Collimator transmission: The movable collimators shall not permit transmission of radiation exceeding 0.5% of the central axis dose at Dmax measured in air for both photon energies iii) Neutron leakage: The neutron leakage rate should not exceed 0.2% expressed in neutron dose equivalent (Sivert) when added to the photon leakage for a 10 x 10 cm field at the isocenter at any point one meter from the target when the jaws are closed
II. Electron Beam Characteristics		
1	Electron Beam Energies	The machine shall be capable of delivering at least five electron beam energies ranging from 4 or 6 to 20MeV.
2	Dose Rate	i) Conventional dose rate mode: The variable dose rate range from 100 to 600 MU/min shall be available. ii) High dose rate mode: A high dose rate electron mode for total skin electron therapy shall be provided with a minimum dose rate of 2500 MU/min or above for the 4 or 6 MeV electron beam.
3	Field Size	i) The electron beam field size is defined by the inside dimensions of the electron beam applicators projected geometrically to a plane surface at 100 cm SSD. ii) A minimum of five applicators with variable sizes range from 6 x 6 cm to 25 x 25 cm shall be provided.
4	Beam Quality	Specify the electron beam quality specification parameter such R50 depth of ionization all offered electron beam energies.
5	Beam Flatness	The maximum percent variation of the electron intensity at 100 cm SSD at D_{max} shall not exceed 5% (within the central 80% of the longitudinal and transverse axes relative to the central axis) for field sizes from 10 x 10 cm to 25 x 25 cm and for all the electron beam energies.
6	Beam Symmetry	i) The maximum percent variation in the average electron intensity to the longitudinal and transverse halves of the electron field at D_{max} for a 10 x 10 and 25 x 25 cm field at 100 cm SSD shall not exceed $\pm$ 2% at gantry angles of 0, 90, 180 and 270 degrees. ii) The average electron intensity is the average of the maximum and minimum points within the central 80% of the field for each of the axes.

7	Beam Penumbra	Specify the penumbra (distance between 80%-20% isodose level at the depth of 0.5x R90). The maximum penumbra shall not exceed 1.75cm for all offered energies
7	X-ray Contamination	The x-ray contamination of the electron beam shall be less than 5% of the maximum dose for all energies specified.
III. Dose Monitoring System		
1	Dose Monitoring System	i) An independent system of two or three internal ionization chambers with built-in digital electrometer should be equipped for monitoring dose, dose rate, beam symmetry and beam steering, with associated interlocks. ii) Radiation beams the beam symmetry shall be less than or equal to 2% and the flatness less than or equal to 3%. iii) An independent back-up timer to indicate accumulated monitor units (MU) if any power failure occurs shall be equipped. iv) The reproducibility tolerance for the dose monitoring system with various measurements such as dose output versus dose rate & dose output versus gantry angle shall be better than 1% or 1 MU.
IV. Linear Accelerator		
1	Magnetron or Klystron	The system must provide with either Magnetron or Klystron as the radiofrequency (RF) micro power source. The warranty should be at least for 5years. (Pro-rata guarantee is not acceptable).
2	Standing/Travelling wave Guide	Standing or travelling type of wave-guide along with the bending magnet, target assembly, vacuum ion-pump should be offered a warranty of 5 years. (Pro-rata guarantee is not acceptable).
3	Target Type &Materials	Specify the target type and materials in details.
4	Flattening Filter	Specify the flattening filter materials in details
5	Electron Gun & Focal Spot	Electron gun should have warranty of minimum 5 years and the beam focal spot should be within 3 mm diameter.
V. Mechanical Features		
1	Isocenter	The mechanical isocentre shall have a maximum diameter of less than or equal to 2 mm for all three rotation axes (collimator,

		gantry and treatment couch).
2	Gantry	A motorized gantry with isocentric design, 100 cm SAD, isocentre clearance greater than 30 cm, and gantry rotation shall be within ±180°.
3	Collimator & Field Size	A collimating head with motorized rotation of at least ±90°. The maximum photon beam field size shall be 40 cm × 40 cm (50% isodose level) at the isocentre.
4	Asymmetric jaw	Asymmetric jaws shall be capable of independent movements of all jaws. At least one set of jaws to cross the central axis over 10 cm shall be possible. Specify the jaw positional accuracy, jaw speed and travel range.
5	Light/Radiation Field	A light field to indicate the radiation field aperture and a reticule to indicate the principal axes and collimator axis of rotation shall be possible. The light/radiation field coincidence shall be less than or equal to 2 mm.
6	Optical Distance Indicator	An optical distance indicator with a range of at least SAD of ± 20 cm shall be possible.
7	Multileaf Collimator	i) An integrated multileaf collimator (MLC) with at least 60 pairs to provide maximum field size of 40x40 cm^2. shall be provided. ii) The MLC leaf width resolution of not more than 5 mm at the isocentre for central field size of 20x40 cm^2 and 10mm for remaining outer area shall be possible. iii) The MLC interleaf leakage shall be less than 4% and the leaf position accuracy less than or equal to 1 mm at the isocentre plane. iv) Specify all other physical characteristic parameters of the offered MLC.
8	Wedge System	System shall be equipped with internal, physical or dynamic wedges providing wedge angles up to 60°. Interlocks shall be provided so that the operator has to positively confirm that the correct wedge has been selected. Specify the maximum possible wedged field size.
9	Optical Front and Back Pointer	A front pointer to locate the mechanical isocentre and an optical back pointer shall be provided.
10	Treatment Table/Couch System	i) A treatment table/couch with motorized lateral, longitudinal and vertical movements with isocentric table rotation up to ±90° shall be possible. ii) Treatment couch with 6-degree-of-freedom (6DOF) in translational and rotational movements' capability and accessories used for image guided radiation therapy shall be provided.

		iii) The table-top shall be of carbon fibre, free of metal or other radio-opaque materials. iv) The couch top shall be indexed to allow reproducible placement of immobilization equipment and also to provide interface for mounting the quality assurance equipment at the head of the couch. v) The lateral range of the couch shall be at least ±20 cm. The longitudinal range of the couch shall be greater than 70 cm. The vertical motion of the couch shall range from the isocentre to at least 60 cm below the isocentre. vi) The sag of the couch top shall be less than 5 mm with a patient of 80 kg weight. The couch shall be able to take a maximum weight of at least 180 kg.
9	Hand Pendants	Hand pendants in the treatment room to allow control of linear accelerator and treatment couch movements shall be provided.
10	Patient Alignment Laser System	Green, remote controlled, fixed lasers mounted on the treatment room walls having two lateral cross lasers, one ceiling cross laser and one sagittal line lasers shall be provided.
VI. In-room Image Guidance System		
1	Electronic Portal Imaging System	i) Integrated amorphous silicon based electronic portal imaging device (EPID) panel mounted on a motorized arm for digital portal imaging shall be provided. ii) System shall be capable of performing on-line and offline 2D MV IGRT corrections strategies. iii) The motorized arm holding the panel shall allow retraction of the panel and allow positioning of the panel at various positions at and below the mechanical isocentre with a range of lateral and longitudinal offsets. iv) The panel shall include an anti-collision system. v) Specify the system active imaging area, spatial and contrast resolution, image acquisition rate, lateral, longitudinal and vertical travel range. vi) Necessary image quality assurance and maintenance tools shall be provided. vii) EPID based 2D portal dosimetry system for IMRT and VMAT patient pretreatment verification for available energies including FFF beams shall be provided.
2	Cone-Beam CT Imaging	i) System shall have an integrated amorphous silicon based flat panel detector and kilovoltage (KV) x-ray source/tube

	System	for generating radiographic, fluoroscopic and 3D and 4D cone beam computed tomography (CBCT) imaging for 2D,3D and 4D IGRT treatment verification with 3D and 6D correction strategies. ii) System shall be capable of acquiring images such as 3DCBCT, pretreatment interfraction 4D-CBCT, either during treatment intrafraction 4D-CBCT or Triggered Imaging, Gated CBCT and Extended Length CBCT etc. iii) System shall be capable of performing reconstruction methods of either feldkamp back projection (FDK) algorithm and/or iterative algorithm. iv) System shall be capable of manual registration, automated bone registration, automated soft tissue registration or gray value based registration methods. v) All Advanced image registration methods of commercially available shall be provided. vi) The offered 3DCBCT image quality should be sufficient to delineate target and critical structure volumes for adaptive planning dose calculations. vii) System shall be able to transfer images to (from) EPID/CBCT from (to) treatment planning system (TPS). viii) Specify the KV generator KV, MAs and exposure time ranges and their accuracy. ix) Specify the KV x-ray tube source/focal spot size, collimation minimum and maximum field sizes, maximum anode heat capacity and heat dissipation rate etc. x) Specify CBCT imaging FOV, HU accuracy and uniformity, spatial resolution, low contrast resolution and slice thickness range as available. xi) Necessary IGRT commissioning and quality assurance phantoms for HU water calibration, image quality phantom, CBCT electron density phantom, and daily MV-KV isocenter alignment QA phantom with analysis software system, KVp multi meter for measuring KVp and tools for measuring focal spot size shall be provided.
VII. Surface Image Guided Radiotherapy System		
1	System Overview	An optical surface imaging system for surface guided radiotherapy (SGRT) shall be provided for the application of patient setup, intra-fraction patient position and target motion monitoring, respiratory gated treatments, frameless cranial radiosurgery and patient safety with following specifications.
2	Optical Camera System	i) System shall have minimum three optical camera pods in

		treatment room and one in the simulation room and shall have a combination of a projector and camera units to capture and reconstruct a real-time 3D surface of the patients. ii) The optical surface imaging system shall have technologies of either the stereo vision or structured light and laser scanner based. iii) Vendor shall specify the scan volume (field of view coverage), image resolution (pixels size) and the scan speed (frame rate) of the offered imaging system.
3	Software Application System	i) Vendor shall provide one software application system inside the treatment room and one in the treatment control console with necessary interface connectivity with treatment system to perform the surface image guided treatment. The system shall have the following functionalities: ii) Use the reference surface image relative to the treatment isocenter position to calculate the necessary correction of the patient position in automatic 6DOF of translational and rotational directions. iii) Real-time motion monitoring of the patient surface throughout the treatment session. iv) Shall have either real-time coaching tools or audio-video feedback goggle systems for better patient breathing pattern reproducibility. v) Provide the guidance for correcting patient posture, such as chin and arm position for better improved patient positioning. vi) The automatic beam hold capability if the patient moves out of a predefined threshold. vii) Able to perform either rigid or deformable image registration. viii) Able to perform either prospective gated treatment at DIBH or retrospective gated treatment in free-breathing conditions. ix) Specify about motion management interface compatibility with commercially available linear accelerators top-end models for prospective or retrospective gated treatment. x) Capable of imaging with bolus accessories. xi) The positioning accuracy of less than 1mm/1^{o} for frameless SRS. xii) Capable of having integrity with existing peripheral systems. xiii) Capable of automatic DICOM RT import/export and network-based data storage.

4	Calibration, Commissioning and Quality Assurance System	Vendor shall provide the system calibration, commissioning and quality assurance (QA) phantoms, accessories/tools/system for periodic QA, and end-to-end QA solution for clinical validation and implementation.
5	Safety Features	i) System shall have the capability of patient facial or other features and accessories recognition for safety. ii) System shall have the capability of having in-built collision detection mechanism.
6	Patient open-face mask immobilization system	i) Vendor shall provide the patient immobilization open-face masks system for 50 patients of cranial SRS treatments.
VIII. Respiratory Motion Management System		
1	Respiratory Monitoring, Control and Gating System for 4DRT	i) An active breathing control system to perform both active breath hold image acquisition and treatment and also for automated respiratory gated treatment including gated VMAT shall be provided with necessary gating system and gating interface system. ii) Shall provide two portable system and the same should allow it to be used in treatment and CT simulation imaging room. Or i) Respiratory synchronized system for respiratory synchronized image acquisition and prospective and retrospective gated treatment shall be provided. ii) System shall be of latest, advanced model commercially available with audio-visual coaching device monitor for better breathing pattern reproducibility. (iii). Shall provide two portable system and the same should allow it to be used in treatment and CT simulation imaging room
IX. Treatment Delivery Techniques		
1	2D and 3DCRT	i) The machine shall be capable of delivering 2D treatment with open, rectangular fields, where the field size and beam angle can be determined at the time of treatment delivery, inside the treatment room (i.e. manual planning based treatments).
2	IMRT and VMAT	i) The machine shall be capable of delivering static and dynamic intensity modulated radiation therapy (IMRT) and also volumetric modulated arc therapy (VMAT). Specify

		about how VMAT delivery is achieved. ii) Capable of delivering high quality intensity modulated fields using fractions of MU. iii) Specify the linac performance for small MU delivery
3	SRS/SBRT	The machine shall be capable of performing frameless image guided stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT).
4	4D and Respiratory Gated Radiotherapy	The machine shall be capable of delivering Deep Inspiration breath-hold (DIBH) and also respiratory-gated treatment to account for phase of respiration of all moving tumors.
6	Electron Beam Therapy	The machine shall be capable of delivering electron beam treatment for superficial tumors.
7	Total Skin Electron Therapy	The offered Linac shall be able to deliver total skin electron therapy (TSET) with 4 MeV or 6 MeV. In case, if the vendor provides linac with 6 MeV for TSET, the necessary energy degrader system and other accessories shall be provided.
X. Treatment Control Console, Display and Accessories		
1	Treatment Control Console	i) All the functions and modes of the accelerator shall be controlled via software, computerized control console system outside the treatment room. ii) The console shall allow activation of the controls so that the accelerator is operational in its various forms. iii) The most important parameters shall be visible in the control console and treatment room. iv) The console shall have a dual login system with various hierarchical modes, including clinical, physics and service modes. v) The console shall interface with an OIS for record and verification of patient treatments.
2	CCTV System	i) A closed circuit colour television system (CCTV) system for viewing of the treatment room from the console shall be provided. ii) There shall be at least two in-room cameras at different locations in the treatment room and the in-room cameras shall have pan and zoom capability.
3	In-Room Monitor	An in-room monitor with display of treatment parameters shall be provided inside the treatment room.

XI. Radiation Safety Features		
	The following radiation safety features shall be provided: i) Beam-on and beam-ready illuminated signs at the entrance and within the treatment room. ii) Ionizing radiation trefoil warning sign at the entrance. iii) Facility access interlocks. iv) Last person out button/last man out switch. v) Audio visual communication between the treatment room and control room. vi) Emergency-off buttons in the treatment room and control room.	
XII. Utility Requirements		
1	Power supply	i) Power conditioner shall be installed to provide precise voltage regulation and protection for the linear accelerator on offer and it should work on three phase 400-440 V / 50 Hz power. ii) UPS of suitable rating with voltage regulation and spike protection for 60 minutes back up for whole linear accelerator systems (including associated TPS, server etc.) should be provided. Resettable over current breaker shall be fitted for protection.
2	Water Chiller System	i) Vendor shall provide a fully automatic water chiller system for sufficient cooling of the linear accelerator. ii) The chiller system shall incorporate an automatic back-up facilities, remote control and alarm panel with warning facilities iii) The water chiller system shall be provided along with the machine by the principals or international standard system
3	Air Conditioning	Specify temperature, relative humidity and air conditioning or air changes required per hour for the offered system.
4	Environmental Requirements	As the LINAC is housed in a concrete bunker to provide radiation protection for staff and members of the public, vendor shall provide the recommendation for operation and storage conditions. The environment inside the linac shall be of climate-controlled, with appropriate temperature and

		humidity control systems, including monitoring to avoid premature material disintegration and/or device failure.
XIII. Equipment Warranty and Maintenance Contract		
1	5 years of Warranty	The vendor shall give mandatory on-site warranty for first five years from the date of commissioning of the entire Linac system (including for all locally supplied items including consumables like batteries of the UPS, printer cartridges etc) from the Principals, except for the wave-guide, beam-bending magnet assembly, electron gun, X-ray tube & RF system, which shall carry guarantee for 10 years. During the warranty period, all the software updates should be provided for free of cost.
2	5 years of Comprehensive Annual Maintenance Contract (CAMC)	i) Vendor shall provide comprehensive annual maintenance contract (CAMC) rate year-wise for quoted machine other accessories for next 5years after warranty period. ii) Spare parts kit should be available for minimum of 10 years and price must be included in the offer. iii) Minimum 95% uptime warranty/guarantee during warranty and CAMC period shall be provided.
XIV. Staff Training and Documentation		
1	Off-Site Training	The vendor should provide comprehensive training on Linear Accelerator, Treatment Planning and Oncology Information system in a well advanced center for three persons (one Radiation Oncologist, one Medical Physicist and one RT technologist). The training period should be at least for two weeks.
2	On-Site Training	On-site application training shall be provided for minimum four weeks to all staff members in the department.
3	Linac Beam Data	Vendor shall provide the Golden data or representative beam data of linear accelerator photon and electron central axis, profile dose curves, as well as flatness and symmetry profiles measured at manufacturer place to verify the measured data at the time of clinical commissioning.
4	Manuals	User/Technical/Maintenance manual to be supplied in English.

XV. General Terms & Conditions		
1	Lowest (L1) Bid Selection	All items are standard features and considered for L1 calculation.
2	List of existing installation of the quoted model equipment	A list of installations existing in the county with satisfactory service certificate, if available from the user, may be submitted to support the claim of a good performance of the equipment. The supplier shall mention the number of installations in India and worldwide, for the quoted model only. Such installations should have been supplied directly by the quoting firm itself. Current performance and status report from the user departments for the model quoted shall be provided.
3	Compliance Statement	All claims regarding meeting the specification should be duly supported by appropriate, latest technical catalogues/brochures from the manufacturer. The vendors shall submit point-wise compliance statement in regard to the specifications asked for in the tender and should mention corresponding page numbers matching with the technical details in the compliance statement.
4	Penalty Clause	Penalty at the rate of Rs.20,000 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 for the given calendar year.
5	Uptime Guarantee	During warranty and the CMC period, the uptime of the system shall be at least 95% of the 365 days in a year. If downtime exceeds 5%, there shall be a penalty of Rs.20, 000/ per day.
6	Calculation of Uptime	The machine shall remain in working condition/fully functional for minimum 347days (being 95% of 365 days) during the year. For leap year, the machine shall remain in working condition/fully functional for minimum 348 days (being 95% of 366 days) during the year. Sunday and other holidays as per the institute policy would be counted calculation of uptime, if the machine was in working condition/fully functional on both days i.e the day preceding Sunday/holiday and the day succeeding Sunday/holiday. Further, routine maintenance as per scheduled agreed by user would be counted towards calculation of uptime. In case downtime is more than 5 hours on any particular day during normal working hours of the

		institute the same day would not count towards uptime calculation.
7	Calculation of Downtime	Down time calculation would start from the reporting of the down time by the representative of the institute by agreed mode of communication i.e. telephonic communication or email or as per the data of the remote access of the machine(s) by supplier, if any, whichever is earlier. The down time would be calculated by deducing total uptime period as defined above from total days of the respective year. Year for the calculation of Uptime/downtime as the case may be would be considered from 01st January to 31st December of the respective year. For purpose of the downtime calculation breakdown of the machine shall be calculated as under. If no radiotherapy is possible then its complete breakdown. If only some functions of the machine are not working for example the EPID or electron cone or laser is not functional in that case it shall be considered as partial breakdown equivalent to 50% of the complete breakdown for calculation purposes.
8	Price Guarantee Statement	The supplier shall also give a commitment that the price quoted for the equipment's in the tender is the minimum price quoted to any institution in the country for similar terms & conditions; whether Government, semi-Government, autonomous or non-Government; in the recent times (preceding six months) and shall remain so for at least the next six months subject to variations in the foreign exchange rates, if applicable.

B. Treatment Planning System Technical Specification

System Overview

The treatment planning system (TPS) is a software application used for the planning of radiotherapy treatment of cancer. The treatment planning system (TPS) shall be capable of performing conventional 2D planning, conformal 3D-planning, inverse treatment planning for IMRT and VMAT and 4D-treatment planning for clinical application of various standard and advanced treatment delivery techniques in radiotherapy. The TPS shall have modules of (i) imaging and registration (ii) contouring/segmentation (iii) planning optimization and dose calculation (iv) plan review and evaluation (v) beam modeling with necessary hardware systems.

General Requirements

The TPS shall include:

1. **Two treatment planning workstations** with dose calculation licenses and **three virtual simulation workstations** without dose calculation licenses shall be provided.

2. The system shall have latest technology of hardware and software features commercially available at the time of delivery.

3. Treatment planning workstations, including dual 26' or higher-inch (Radiology standard medical grade) monitor printer, keyboard, mouse with network capability.

4. The system shall be integrated with CT-Simulator, MRI, PET and linear accelerators, oncology information system, dosimetry equipment and hospital PACS system.

5. Display of all relevant planning and treatment system parameters shall be in accordance with the IEC 61217 scale and coordinate convention.

6. Vendor shall provide the each unit price of both TPS and workstations offered.

The offered system shall have the following technical specifications.

S.No	Features	Technical Specification
1	Imaging and Image Registration	i) System shall enable import of patient data sets from various imaging modalities that are used to facilitate target definition using the DICOM standard. ii) Image import shall be achieved through direct connectivity and also provision to be used through CD/DVD media. iii) The Networking with picture archiving and communication system (PACS) system. iv) System shall support for CT, MRI, CBCT, and PET registration. v) System shall use both rigid and deformable image registration vi) Specify the type of DIR methods available in the offered system. vii) Deformable image registration shall be capable of fusing CT and CBCT images.

2	Contouring/ Segmentation	i) Contouring tools shall allow the definition in 3D of structures, including target, organs at risk and patient outline. ii) Automated tools shall allow the expansion of the clinical target volume (CTV) to a planning target volume (PTV) with non-uniform margins in three dimensions. iii) System shall have ability to add bolus structures to the patient data set of various shape and density. iv) System shall be capable of 3D visualization of patient data display, beam display and dose distribution display. v) System shall have the following advanced contouring and segmentation functionalities: a) Multi-modality contouring b) 4D image dataset support- MIP, AIP, and minIP image creation c) Auto PET SUV contouring d) Advanced Boolean operations e) Atlas-based autosegmentation

3	Planning, Optimization and Dose Calculation	The offered system shall have the following basic and advanced planning and optimization functionalities: i) A comprehensive “forward planning” environment shall allow the user to modify beam weights, beam positioning, jaw position, wedges and blocks, or MLC to optimize the treatment plan. ii) 2D, 3D, electron planning and composite planning iii) Field-in-field forward IMRT planning iv) Dynamic conformal arc planning v) Static and dynamic IMRT and VMAT planning vi) 4D treatment planning vii) SRS/SBRT treatment planning viii) Automated planning using Scripting application-based planning or Protocol-driven template based planning. ix) Physical DVH based optimization, Biological optimization and Multi-criteria optimization (MCO) x) The photon beam algorithm shall use advanced kernal methods such as convolution/superposition, Boltzmann transport ACUROS or Monte- Carlo based. xi) The electron beam algorithm shall be based on Monte Carlo methods. xii) Photon beam and electron beam algorithms shall calculate the dose to the patient considering the 3D nature and heterogeneity of the patient data set. xiii) The dose calculation grid shall be user adjustable for desired, better dose calculations accuracy. xiv) The system shall allow the dose prescription to a point, volume or isodose line.

4	Plan Review and Approval	i) System shall have basic and advanced plan review and evaluation tools such as dose volume histograms (DVHs), dose statistics, 2D and3D dose visualization, and plan addition and plan comparison. ii) System shall also have the Radiobiological model-based treatment response evaluation tools such as BED/EQD or TCP and NTCP. iii) System shall be able to generate, view and transfer DRRs. iv) User and password security shall allow approval/locking of treatment plans and different levels of access to the functionality of the TPS based on the user's profile, e.g. administrator, planner, medical physicist, radiation oncologist.
5	Beam Modeling	i) Comprehensive beam modeling module shall allow the configuration of complete geometric and dosimetric models for treatment unit with photon and electron beams. ii) The module shall have the following features: 1. Ability to import measured beam profiles and output factors. 2. Ability to model dynamic, fixed and internal wedges. 3. Tools to allow the comparison of the beam model and measured data. iii) Security features that protect beam data and beam models from modification. iv) A module shall allow the creation of CT number to mass density or electron density data for various CT scanners for use by the photon and electron beam algorithms.
6	Plan Output and Networking Connectivity	i) A laser printer for A3/A4 output of isodose distributions, beam shapes and treatment plan parameters shall be provided. ii) System shall allow export of beam block shapes to a third party block cutting device. iii) System shall allow export of approved treatment plans and DRRs to an oncology information system (OIS). iv) System shall be capable of connecting with existing Elekta linear accelerators with VMAT capability in the department and necessary DICOM-RT import and export shall be possible. v) System shall haveHL-7 and IHE-RO compliant capability.
7	TPS Hardware Specification	The system shall have latest technology of hardware and software features having vendor recommended specification of the system commercially available at the time of delivery, not minimum specification.

8	Date Storage and Back-up Facility	i) Vendor shall provide Rack-mounted server having storage capacity of 20TB along with integrated oncology information system. (ii). Specify the strategies for storage back-up, archive and retrieval of the data.

C. Oncology Information System Technical Specification

System Overview

The oncology information system (OIS) is a software application that manages the workflow and storage the electronic information, including patient data in the radiation oncology department. The OIS is useful as (i) record and verify system (ii) to transfer treatment plan information and images from the TPS to the treatment unit (iii) to record detailed dose delivery information and images for each treatment session (iv) image review module (v) manage the patient care pathway (vi) electronic patient record and manage staff workflow through defined tasks (vii) treatment unit schedules and appointments.

General Requirements

1. The offered OIS shall be compatible with existing OIS, Linac and TPS in the radiation oncology department at Dr.B.R.A.IRCH.

2. Either single server or two server (one for data storage and one for image storage) having data storage capacity of 20TB and **Three OIS workstations** with concurrent licenses shall be provided.

3. The system shall be integrated with CT-Simulator, MRI, PET and linear accelerators, treatment planning system, dosimetry equipment and hospital PACS.

4. The OIS shall use the DICOM RT standard for transfer of radiation oncology specific electronic information and shall comply with IEC 62274:2005 standards.

5. The OIS shall include a secure, remote servers and workstations at least 23-inch monitors, printer, keyboard, mouse with network capability.

6. An UPS, including an automated daily back-up system to an external hard drive (or equivalent) with auto detect and auto-shutdown after 30 minutes in the event of a power failure.

The offered system shall have the following technical specifications.

S.No	Items/Features	Technical Specification
1	OIS Software Workstation	OIS workstations shall be capable of: i) Manual data entry of 2D cases, clinical mark-ups and emergencies. ii) Approval and entry of prescriptions and free text setup instructions. iii) Upload of photographic images. iv) Electronic chart checks. v) Image review of DRRs and treatment images (portal and setup) vi) Networking to the TPS to allow import of the patient administration data, beam delivery parameters and DRRs of graphically planned patients. vii) The importation of data should be customized to correctly download and translate the TPS information to the scales and graduations of the department treatment units. viii) A fully integrated workstation shall be provided for each of the treatment units, including all interfaces to fully operationalize the system for automated download and verification of the treatment parameters as well as capture and storage of portal and setup images. ix) The workstations should include an in-room alternative monitor to facilitate patient identification and viewing of the setup instructions, including digital images. x) The system should be supported by a local UPS such that there is no loss of data in the event of a power failure to the treatment unit.

2		**Software shall have the further following functionalities:** i) Hierarchical security features, including requirement for authorized approval of the dose prescription and field parameters prior to treatment. ii) Complete log of activities and users. iii) Generation of statistical data according to user-defined fields, e.g. diagnosis and managing consultant. iv) Library of diagnoses according to the WHO *International classification of diseases*, (ICD-10). v) Ability to correctly log cumulative dose in the event of a treatment interruption or termination. vi) Patient appointment scheduling.
3	OIS Hardware specification	The system shall have latest technology of hardware and software features having vendor recommended specification of the system commercially available at the time of delivery, not minimum specification. Vendor shall provide Rack-mounted server having storage capacity of 20TB along with TPS.

D. Dosimetry and Quality Control Equipment Specification

System Overview

Dosimetry and quality assurance equipment are required to measure of radiation beam output, central axis depth dose and beam profiles and isodose curves for characterizing and modeling and commissioning the LINAC beam in the treatment planning. In addition, the same equipment shall also use for the clinical validation, end-to-end quality assurance of treatment process, patient treatment quality assurance and also for periodic machine quality assurance and quality control procedures as required for national regulatory safety compliance.

General requirements:

1. All dosimetry, quality assurance equipment offered shall have FDA (USA) and CE (Europe) certified medical device category.

2. Vendor shall quote the separate price for dosimetry and quality control equipment and also the unit price of each items.

S. No	Name of Item/Feature	Technical Specification	Quantity
Reference Dosimetry Equipment			
1	Farmer type	i. Waterproof Farmer type ionization chamber for	2 No.

	ionization chamber	reference dosimetry with graphite wall material. Active volume approximately 0.6 cm^3 with TNC or BNC connector. SSDL or PSDL calibration in terms of absorbed dose to water in conjunction with an electrometer. ii. Build-up cap of PMMA based for cobalt-60 and brass based for 6MV, 10MV and 15MV X-ray beams shall be provided.	2 No. each
2	Plane parallel ionization chamber	Plane parallel chamber volume with approximately 0.4cm^3 or equivalent for electron beam reference dosimetry with BNC or TNC connector	2 No
3	Reference class electrometer	Single channel electrometer for radiotherapy dosimetry reference class, BNC or TNC connector including carry case.	2 No
4	Small field dosimetry system	The small size 0.07 cm^3 or equivalent ion-chamber having high spatial resolution for measurements in small field and FFF fields for absolute and relative and beam commissioning dosimetry.	2 No
5	Solid Slab phantom	Set of plates manufactured of water equivalent material consisting of at least one plate of 0.1 cm thickness, two plates of 0.2 cm thickness, one plate of 0.5 cm thickness and 29 plates of 10 mm thickness. Plate outer dimensions: 30 cm x 30 cm. Adapter plates for Farmer type chamber, 0.125 cm^3 or equivalent thimble chamber, 0.4 cm^3 or equivalent plane parallel chambers.	2 No
Relative Dosimetry Equipment			
1	Radiation Beam Data Acquisition System	3D scanning water phantom of square/rectangular shape for linear accelerator beam commissioning dosimetry and annual QA. The system shall have automatic setup for beam canter adjustment and auto field alignment capability. The system shall consist of 3D scanning water tank, lift table, water reservoir, electrometer/controller, beam data acquisition software with latest laptop computer, two approximately 0.125cm^3 or equivalent water proof ionization chambers and associated holders and cables.	2 No

	(a) 3D water scanning square phantom (b) Detectors- waterproof two ion chambers with holders. (c) Built-in dual electrometer with control unit. (d) Software system with latest high end configuration laptop system.	i. Water tank scanning square/rectangular phantom dimensions of at least to 480 x 480 x 400 mm^3 ii. Detector position accuracy of ±0.1 mm and position reproducibility of ±0.1 mm. iii. Water tank with motorized scanning capability in the X, Y and Z planes for ionization chambers or diode detectors. iv. A lift table with vertical travel range of 500 mm and rotation in the XY plane of ±5 degrees. v. A dual electrometer system and control unit with bias range of 50–400 V, minimum resolution of 10 fA, and leakage current <250 fA. vi. A control unit to control movement of moving mechanisms and interface with electrometer. vii. A water reservoir with bi-directional water transport to and from the water tank and volume capacity more than 200 liters. viii. One portable latest high-end model laptop computer with Windows operating system with connectivity to the control unit. ix. Software for data acquisition with scan optimization, data handling and analysis and TPS transfer environment. x. A software feature to allow export of beam profile data or depth dose data in text format to Microsoft Notepad or Excel is desirable. xi. Software modules should allow transfer of beam data to any commercially available TPS. xii. Two waterproof thimble chambers of active volume approximately 0.125 cm^3 or equivalent. xiii. Holders for Farmer, thimble, plane parallel and diode detectors. xiv. Connector cables between the computer, controller and water tank.	

2	Radiochromic films	i. Self-developing radiochromic film with sensitivity up to 20 Gy for radiotherapy dosimetry and QA applications shall be provided initial commissioning time and also as and when the department demands for the same. ii. EBT3 or latest Gafchromic film size: 14 x 17 inch EBT3 or latest Gafchromic film size: 8 x 10 inch	50 sheets each
Quality Assurance and Control Equipment/System			
1	Machine QA Equipment/System Daily QA	Vendor shall provide the ion chamber based standalone daily QA device/system to perform X-ray and electron output, flatness and symmetry of beam profile, beam energy constancy test etc. for field sizes range from 10x10 to 20x20 cm^3. It shall be suitable for FFF beams. Vendor shall provide appropriate software system for analyzing, reporting and QA data management.	2 No
2	Patient-Specific IMRT and VMAT Verification QA Equipment/System	The system shall consist of (a) 3D cylindrical phantom (b) 2D ion chamber or diode array based detector (c) software system for IMRT and VMAT FFF beams having advanced comparison and evaluation tools including local and global gamma volume analysis as per AAPM TG-218 recommendations.	2No.
Radiation Safety Equipment			
1	Survey meter	A portable ionization chamber-based survey meter capable of detecting X-ray and gamma radiation above 25 keV, integrated display, dose rate and integrated dose modes, dose rate range of 0.5 µSv/hr – 50 mSv/hr, energy dependence less than 20% in the range of 50 keV–1 MeV, calibration certificate shall be provided.	2 No.
2	Neutron meter (if photon energies 10 MV or higher in clinical use)	A spherical rem-counter probe that can be used for measurement of ambient dose equivalent rate (Sv/hr) for neutrons according to the International Commission on Radiological Protection (ICRP) Publication 60. Measuring range of 30 nSv/hr–80 mSv/hr shall be covered and the energy dependence shall be around ±30% of 50 keV–10 MeV. The sensitivity shall be less than 3 counts per nSv. The probe shall have a calibration that is traceable to primary standards.	1No.

E. Patient Positioning and Immobilization Devices Specification

System Overview

Patient positioning and immobilization devices are accessory tools which are used to prevent patient movement during radiation treatment with linear accelerator. The patient positioning and immobilization system shall consist of base plate, thermoplastics masks, vacuum bags and other additional support systems for particular anatomical site-specific tools.

General Requirements:

1. All patient positioning and immobilization devices offered shall have FDA (USA) and CE (Europe) certified product.

2. As the patient positioning and immobilization devices such as fixation materials, couch top and thermoplastics mask alter the patient dose of radiation significantly as per the AAPM TG-176 findings, the product of vendors those who will provide with FDA endorsed data of dosimetric properties of all offered devices are only eligible for the bidding.

3. Vendor shall the freeze price as rate contract for 2 years for supplying the thermoplastics masks suitable for the offered system.

4. Vendor shall quote the separate price for patient positioning and immobilization and also the unit price of the items.

S. No	Item/Feature	Technical Specification	Quantity
		Brain	
1	Base Plate	Universal treatment Base plate made of carbon-fiber materials with three-point fixation option with CT-compatible.	5 No.
2	Three-point Thermoplastic Masks	Thermoplastic material suitable for three-point head base frame having good memory for remolding capacity with all necessary support systems.	100 No.
		Head and Neck	
3	Base Plate	Base plate made of carbon-fiber materials with five-point thermoplastic masks for head and neck with CT-compatible.	5 No.
4	Five-point Thermoplastic Masks	Thermoplastic material suitable for five-point head and neck frame shall be provided.	100 No.
5	Head Support	Full sets (A, B, C, D, E and F) of Carbon fibre suitable for the above mentioned Brain and Head and Neck Base Plates.	5 each
		Breast	
6	Breast Board Supine	Breast board for supine patient treatment made of carbon fibre materials with different angulations, arm support, wrist support with grip hole and knee support having facility for thermoplastics.	2 No.
7	Breast Board	Breast board for prone patient support, capable of	2 No.

	Prone	angling up to 25 degree, including arm and wrist support, CT-compatible.	
Thorax			
8	Wing board or equivalent support system	Wing board or equivalent support system with hand grips having CT-compatible shall be provided.	3 No.
Abdomen and Pelvis			
9	Vacuum bags	Vacuum bag with skin of durable plastic or polyurethane casts in three different sizes (small, medium and large) shall be provided.	10 each sizes.
10	Knee support	knee support	5 sets
11	Feet support	feet support	5 sets
12	Vacuum Compressor	Compressor for vacuum bags capable of both inflates and deflates cycles including connector.	1No.
Paediatric			
13	Three-point thermoplastic masks	thermoplastic material suitable for three-point head base frame	100 No.
14	Five-point thermoplastic masks	thermoplastic material suitable for five-point head base frame	100 No.
15	Paediatric headrests	Supine and prone paediatric headrests	10 No.
16	Vacuum bags	Vacuum bag with skin of durable plastic or polyurethane casts size of 70 cm x 70 cm.	10 No.
Common Other Ancillary Items			
17	Bolus	The bolus build-up materials made up of a solid, homogenous, uniform, tissue equivalent oil gel with a density of 1.03 g/cc approved by FDA for human contact is encased in a tough layer of thin plastic. Size: 30 x 30 cm^2 Thickness : 0.5, 1.0, 1.5, 2.0 cm	10 each thickness
18	Sciessors (sharp)	Capable of cutting braces	5 sets
18	Eye Shields	2mm tungsten eye shield specifically for 6 and 9 MeV electron radiation, coated with minimum 2mm of dental acrylic.	5 set
19	Shield block	Full Shield set (box)	2
20	Cross Markers	Patient Markers	20 boxes
21	Shield block tray	Both dot and slit cut tray in full carbon	10 each
22	CT Makers	Lead balls (2.5 or 3 mm)	200

24	Treatment Brassieres	Full Brassier Library of 40 cups in portable “caddy”	1
25	Mould Room Couch	Electronically height adjustable base on lockable castors with fully indexed carbon fibre top, and capable to lowering the table top up to minimum height of 40-43 cm in order to load the patients. Trolly type and mobile.	1
26	Lasers	Both sagittal and transverse for Mould Room Couch	1

F. Turnkey Scope of Work for Facility Site

General Requirements

1. The Supplier should inspect the proposed site wherein the LINAC has to be installed. They are required to prepare and submit plan for the project. The scope of turnkey work includes complete Civil, Electrical, Air-conditioning and Plumbing for the proper functioning of the LINAC. The supplier shall assist the user by facilitating necessary documentations/technical data for regulatory clearances and approvals from AERB (The site plan is attached herewith as Annexure I).

2. The cost of the facility 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 Modification work.
   i. Electrical work
   ii. Air conditioning (HVAC)
   iii. Flooring
   iv. Wall Finishing & Painting
   v. False Ceiling
   vi. Plumbing.

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 Modification work executed at the supplier at the site.

5. Bidder should clearly mention break-up price of each component of Site Modification 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. Furniture like desks, chairs, shelves etc. Air-conditioning of the LINAC facility and the price quoted for 15 TR HVAC is included for L1 calculation of the bids.

8. The LINAC Facility shall consist of the following rooms:
   a LINAC Treatment Room
   b Console room

c UPS room
d Electrical work

9. The supplier shall be required to specify the total load requirements for the LINAC facility 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 LINAC facility. The mains panel and distribution panel for LINAC, HVAC, and LIGHTING should be provided by the supplier. Few lights in LINAC, CONSOLE ROOMS, UPS ROOM shall be connected to the UPS to provide emergency lighting.

10. The bidder may quote the unit rates of any other site modification 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 should be completed. 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 LINAC; CT-SIMULATOR & LINAC 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 with copper plate for the LINAC and all accessories like UPS and Chiller. The earthing for the AC should 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 – Mirror optical type 1X28 W or 2X28 W/CFL fittings 2X36, 3X36 W with electronic ballasts to be provided in all areas. 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 Modification 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. In the case of LINAC-CHILLER is placed indoors, the Air-conditioning system should be able to provide adequate ventilation and heat exchange for the same.

3. The outdoor units of AC should have grill coverings to prevent theft and damage.

4. Stand -alone Room Dehumidifers of adequate capacity for LINAC Room, Console Room and TPS Room to ensure condensation- free atmosphere for the high value equipment.

Environment specifications:
Humidity range: Relative humidity 60% and 80% in all areas except equipment room which shall be as per requirement of the equipment.

5. Temperature ranges: 22 ± 2° 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 LINAC 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 and specification."

2. 50mm thick cement concrete flooring with 3mm Vinyl flooring in UPS Room / Equipment Room

3. 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.

4. The LINAC room, Console Room & UPS Room will be made rodent /pest proof.

5. 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 and 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.
2. Vendor should provide the KOPE light with interior decoration in the LINAC room.

MISCELLANEOUS:

1. The LINAC room shall be provided with wall-mounted storage cupboards within LINAC room; to store: Dosimetry & QA Items, LINAC accessories.

2. Sufficient number of Open Racks of high Quality vendors should be provided to house the immobilization materials; within LINAC room

3. TPS room should be provided with LED X-ray film viewer with adjustable brightness; capable of holding 3 films of 14"x17" size-2 nos.

4. The 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 and TPS room - 10 Nos.

2. "Workstation Tables for Console room & TPS room:
   The Console room and TPS room should be provided with suitable workstations(s) of reputed brand, to accommodate the various Terminals in Console Room and TPS Room. The Workstation shall be providing with enough power sockets, LAN sockets etc. to enable smooth functioning of the LINAC and TPS. And also Shoe Rack- 02 shall be provided.

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 CONDITIONING** -Daikin, Hitachi, Blue Star, Voltas

C **FURNITURE** -Hermen Miller, Godrej, Featherlite, Wipro

D **FALSE CEILING** - Armstrong, Saint Gobain, Luxalon.

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