



# INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

## MATERIALS MANAGEMENT DIVISION

PR No. 1000043527

RFx No. 6100001966

### Technical Specification of Intraoperative Radiotherapy Machines (X-ray based ,Flash Machines, Mobile LINAC) (X-ray Irradiator)

Items	Technical Specifications	Quantity	Compliance
Purpose	X Ray Irradiation chamber should be suitable for irradiation of larger cell culture flask or laboratory animals at various dose rates ranging from 0.01Gy /min up to > 12 Gy/min. Applicable for: - <i>In vitro / in vivo</i> whole body irradiation		
Overall capability of the equipment	<ul style="list-style-type: none"> <li>- System should be high throughput of irradiating upto 1- 30 mice</li> <li>- Whole body irradiation per run along with nose cone upto 1-5 mice.</li> <li>- Provision of entry port for to introduce small tubing and cables into chamber area.</li> <li>- Should have dose measurement System and Calibration.</li> <li>- Calibration capable of being positioned at multiple points in the chamber</li> </ul>		
Chamber specifications	Interior - Type 316 stainless steel X-ray cabinet specifications: Height: ~2090mm Width: ~1000mm Depth: ~810mm		
	Chamber specifications Width: ~570mm Depth: ~600mm Height: ~650mm		
	Specimen table dimensions Width: ~520mm Depth: ~580mm Table thickness: ~10mm		

X-ray Tube Specifications	<ul style="list-style-type: none"> <li>- Unipolar water-cooled X-ray tube with integrated radiation protection.</li> <li>- Automatic warm up with intelligent tube conditioning and sensing</li> <li>- Metal ceramic, Fixed Anode, Water cooled.</li> <li>- Single Focal Spot: 5.5 – 8 mm</li> <li>- Dual Focal spot with optimax ; 1 mm, 5.5 mm</li> <li>- X-ray Tube Output Limits:</li> <li>- Voltage: 20-225kv</li> <li>- Current: Up to 30 mA within the operating limit of the system</li> <li>- Power: 3.2 kW (maximum continuous rating)</li> <li>- X-ray Tube Specifications</li> <li>- Focal spot size (EN12543): D - 8mm</li> <li>- Target material: Tungsten</li> <li>- Inherent filtration: 0.8+-0.1mm Be</li> <li>- Tube power continuous max: 4000W</li> <li>- Radiation coverage total: 40degree</li> <li>- X-ray tube radiation leakage (max) at 1 m distance 0.2 mSv/hour at 225 kV @ 13 mA</li> <li>- Terminal type: R24</li> </ul>		
Dose Rate Stability	<ul style="list-style-type: none"> <li>- Reproducibility (as IEC 60601-2-8): Reproducibility for the time system for each energy is <math>\leq 1\%</math></li> <li>- Linearity (as IEC 60601-2-8): Linearity of the time system is better than <math>\pm 1\%</math> or 1 cGy, whichever is greater.</li> <li>- Dose delivery range - system should be able to deliver low dose range as low as few cGy to many Gy per minute with options of multiple filters.&gt; 9 Gy/min Raw X Ray output ( No beam filtering ) upto few cGy with Beam filtering.</li> </ul>		
Generator specifications	<ul style="list-style-type: none"> <li>- Maximum Power: 4000W</li> <li>- kV Range: 20-225kV</li> <li>- kV Accuracy: <math>\pm 1\%</math> of demand value</li> <li>- kV Reproducibility: Better than <math>\pm 0.05</math> kV</li> <li>- High Voltage Ripple:&lt; 5.0 V/mA with 10 m high voltage cable</li> </ul>		

	<ul style="list-style-type: none"> <li>- mA Range: 1 to 30 mA (auto power restricted)</li> <li>- mA Accuracy: <math>\pm 0.5\%</math> of demand value</li> <li>- mA Reproducibility: Better than 2 <math>\mu\text{A}</math></li> <li>- Drive Frequency: 25 KHz</li> <li>- Rise Time (per second): 40 kV/sec and 3.125 mA/sec</li> <li>- Minimum Impedance Limit: 1 Meg <math>\Omega</math></li> <li>- Input Voltage: 220V <math>\pm 10\%</math> (47 to 63 Hz) <ul style="list-style-type: none"> <li>- Input Current: 27A at 220V</li> <li>- Output Connector: R30</li> <li>- Dimensions Cathode (w x h x d): 435 x 780 x 818 mm</li> <li>- Storage Temperature: -40°C to +70°C</li> <li>- Operating Temperature: 0°C to 40°C</li> <li>- Relative Humidity: <math>\leq 95\%</math> (non-condensing)</li> </ul> </li> </ul>		
Filters	Aluminium filter: 3mm Al, ~7.25mm Al HVL		
	Copper filter: ~0.5mm Cu, custom flattened filter to give 95% homogeneity over 90% of field. ~1.09mm Cu HVL		
	Changeable Beam Conditioning filter slides for different dose rates		
Cooling System	<p>The X Ray irradiator employ either a water-to-water or water-to-air cooling system, which continuously maintains the optimum working temperature of the X-ray tube</p> <p><b>Water-to-Water Cooler Specifications:</b></p> <ul style="list-style-type: none"> <li>- Noise level: 47 dB(A) (50 hz) @ 1 metre</li> <li>- Cooling medium: Water or water/inhibitor mix</li> <li>- Cooling capacity: 3000W</li> <li>- Water flow: &gt; 5.4 l/min at 4.0 Bar</li> <li>- Ambient temperature: 0 to 40°C</li> <li>- Air humidity: 10% to 90%</li> <li>- Storage temperatures limits: -20 to +70°C</li> <li>- Pressure drop across heat exchanger : &lt; 0.5 Bar</li> </ul>		

	<ul style="list-style-type: none"> <li>- Minimum pressure distance between source and drain: 1.0 Bar</li> <li>- Maximum inlet pressure: 6 Bar</li> <li>- Maximum cooling water temperature: 25°C</li> <li>- Supply: 230V ± 10%, 50/60 Hz, 1.7A Supply (powered)</li> <li>- Dimensions (l x w x d ): 450 mm x 270 mm x 400 mm</li> </ul> <p><b>Water-to-Air Cooler Specifications:</b></p> <ul style="list-style-type: none"> <li>- The water-to-air cooling system is a heat exchanger with a reservoir of water circulated through the X-ray tube to remove the heat generated when producing X-rays.</li> <li>- Noise level: 47 dB(A) (50 hz) @ 1 metre</li> <li>- Cooling medium Water or water/inhibitor mix</li> <li>- Cooling capacity: 3000W</li> <li>- Water flow: &gt; 5.4 l/min at 4.0 Bar</li> <li>- Ambient temperature: 0 to 40°C</li> <li>- Air humidity: 10% to 90%</li> <li>- Storage temperatures limits-20 to +70°C</li> <li>- Pressure drop across heat exchanger: &lt; 0.5 Bar</li> <li>- Minimum pressure distance between source and drain: 1.0 Bar</li> <li>- Maximum inlet pressure: 6 Bar</li> <li>- Maximum cooling water temperature: 25°C</li> <li>- Supply: 230V ± 10%, 50/60 Hz, 1.7A supply</li> <li>- Dimensions (l x w x d): 450 mm x 270 mm x 400 mm</li> </ul>		
Electrical Specifications	<ul style="list-style-type: none"> <li>- Voltage Supply: 230V ± 10% 47/63 Hz; single-phase</li> <li>- Power Consumption: 27A phase-to-neutral (recommended customer fuse 45A minimum)</li> <li>- Protection: Surge protection is recommended</li> </ul>		
Interface Features	<ul style="list-style-type: none"> <li>- On-unit, graphical user touch-screen interface (in build PC for operations) Individual user</li> </ul>		

	<p>passwords required for system operation</p> <ul style="list-style-type: none"> <li>- Up to 9999 individual accounts can be</li> <li>- created Excel database of exposure and</li> <li>- user history can be downloaded using USB drive</li> <li>- Programmed exposure settings, database management and user passwords controlled by an administrative Super User</li> <li>- External internet-based diagnostics and software updates</li> </ul>		
Operators Control	<ul style="list-style-type: none"> <li>- kV Setting + Display Accuracy: 5kV - 225kV in 0.1kV increments mA</li> <li>- Setting +Display Accuracy: 0.5mA - 30mA in 0.01mA increments</li> <li>- Settings Accuracy: &lt; 1%</li> <li>- Exposure Timer: 1 - 99999 seconds</li> <li>- Programmable Settings:</li> <li>- 1000's of locations or recall exposure parameters</li> <li>- Standard Accessory included - Manual Sample shelf and 1Al and 1Cu filters. (2 filters)</li> <li>- Integrated light and camera for real time viewing.</li> </ul>		
Isocenter Laser Alignment System	Isocenter Laser Alignment System for accurate positioning of samples and specimens		
CCTV video system	For continuous monitoring of samples and specimens in the irradiation chamber		
Touch screen control panel	Touch Screen X-ray Control Panel Mounted on a movable arm allowing optimal positioning		
Provision for anaesthesia	System should have facility to accommodate the "Active or Passive Gas anesthesia system" cables and other accessories for continuous irradiation of mice /rat		
User Protection	- Entire X ray irradiator should have Lead shielding to ensure with exterior leakage less than 0.5 uSv/hr at 10 cm as per international standards		

Accessories	<ul style="list-style-type: none"> <li>- 12 and 33 section Mouse Pie cage – 1 each number</li> <li>- Nose cone for mice and rats: 12 numbers each</li> <li>- Dynamic Collimator</li> <li>- Autoclavable Pie cage for whole body irradiation -1No</li> <li>- Additional anaesthesia tubing should be provided for connecting to the X ray irradiator chamber.</li> <li>- Programmable Shelf with Turntable</li> </ul>		
Computer with software (Dose calculation/Simulation)	<ul style="list-style-type: none"> <li>- Can be installed on any compatible PC. Allows accurate dose and beam-on time</li> <li>- calculation for in-vivo and in-vitro samples with detailed display of the dose distribution.</li> <li>- Aids reproducibility, accuracy, and reporting of irradiations</li> </ul>		
External dose measurement system and calibration	The external dosimeter allows users to get internal dose readings via water or air. The products in this set provide easy calibration of the internal dosimetry system.		
After sales support/ service / Application support:	System should be supported by manufacturer or their authorized distributor with factory trained Service engineer.		
Training	Training on operation and basic maintenance should be given at the time of installation for one week.		
Regulatory / AERB	X Ray irradiator should have been AERB Approved with valid Type approval document. Should have also meet international safety guidelines/certifications.		
Others	<ul style="list-style-type: none"> <li>- Service: A certified service engineer should be easily accessible and available on demand within 48 hours of any problem in the instrument. Two compulsory visit per year for maintenance must be included apart from the installation.</li> <li>- Spares: The supplier of the instrument must confirm in writing that the spares for the entire instrument will be available for a period of at least ten</li> </ul>		

	<p>years after the installation of the instrument.</p> <p>- Manual: One set of operating manual and service manual (in English) should be provided with the instrument.</p>		
Warranty	- Standard 3 years		