

MEDICAL LINAC

Medical linac is an electrical machine that generates & delivers Bremsstrahlung (braking radiation) to the affected portion of the patient's body to the extent required on command. It uses high power microwaves to set-up an accelerating field in the linac tube where electrons are accelerated to 6 MeV energy and are suddenly stopped by the target producing Bremsstrahlung. A Medical Linac is used for treating malignant tumors using photons. This treatment is done for cancer patients either in combination with surgery/chemotherapy or solely using radiotherapy. About 70% of the patients, who need radiotherapy, are treated using 6 MV photons. Worldwide only three companies make medical linacs. In the recent times, new features have been added to deliver IMRT & IGRT in order to have precise dose delivered to the affected tumor while sparing the healthy region. This microwave source is electrically powered and controlled using FPGA controls for precise dose delivery. The patient is positioned on couch suitably and optics is used for appropriate patient alignment. No radiation is generated in BEAM OFF condition. There is no radioactive waste generated. Radiotherapy is administered to a patient after proper planning using 3 Dimensional Treatment Planning System (3D - TPS). The total dose to be delivered to a patient is typically fractionated over a period of 3 weeks or so with each day's exposure of about 200 cGray depending on the type of tumor.



LINAC TUBE

The heart of the linac cancer therapy machine is the linear accelerator or linac tube. It is a high technology component of the machine, the fabrication of which is highly process intensive. SAMEER has, over the years, developed the requisite technologies for in-house making of the linac tube.

GANTRY AND STAND

Gantry houses Linac tube, microwave system, collimators, optical systems and cooling water bus bars. The gantry is coupled to a rigid vertical stand through a bearing. It rotates smoothly through a useful range of 360° at a speed of 0.1 to 1 rpm with the help of a control motor. The source to axis distance is 100 cm as per international standards. The source rotates isocentrically along with the gantry. There is a gap of 40 cm between the isocenter and the wedge tray. This provides sufficient space for treatment accessories. The stand houses the HV modulator rack on the top, the power distribution board, motor drives and power supplies.



HYDROGEN BRAZING FURNACE

SAMEER developed its first compact standing wave linac tube in the early 1980s. The specifications of the tube are comparable with those used in similar machines available in the world market. Over the years, SAMEER has upgraded its laboratory facilities to deliver reliable tubes processed within a shorter time frame. It has precision machining facility, clean room assembly stations, brazing furnaces, vacuum baking facility, well equipped microwave measurement set-up, better vacuum stations and new radiation shielded facility with latest dosimetry equipment.



RADIATION HEAD & COLLIMATOR ASSEMBLY

The primary collimator with a beam shaping cone of 28° shapes the X-Ray beam to 49 cm diameter circular field at the isocenter. The field flattening filter makes the X-Ray intensity uniform in all directions on a plane perpendicular to cone axis. The motorized secondary collimator shapes the X-Ray field into a rectangle continuously variable from 0 x 0 to 35 x 35 cm at the isocentre. In addition the secondary collimator can be rotated $\pm 95^\circ$ around the beam centre line. The ionization chambers measure the X-Ray dose.

MODULATOR RACK

A modular rack mounted on a tubular frame in upper half of stand with EMC compliant layout of the sub-assemblies of the High Voltage Transmission Line Type Modulator.

HIGH POWER MICROWAVE SYSTEM

A tunable magnetron housed in a demountable frame drives the microwave system with a high power water load for matching.

PATIENT SUPPORT ASSEMBLY (PATIENT COUCH)

The Patient Support Assembly with indigenous monolithic carbon fiber top supports treatment from all gantry rotation angles. The longitudinal, transverse, vertical and isocentric rotations facilitate suitable patient positioning. The couch movements can be done using either from keypads on PSA or hand held pendant. The position parameters can be seen on the dial display as well as on the monitors (treatment room and control room).

COMPUTER CONTROLS

The Linac machine is controlled by a master control system which uses embedded software & FPGA based firmware. The movement controls are PLC based & the operator administers treatment using graphical user interface.

TRANSFER OF TECHNOLOGY

On non-exclusive basis, the technology of 6 MV medical linac SIDDHARTH is under transfer to M/s. Panacea Medical Technologies, Bengaluru. SAMEER laboratories at IIT Powai campus & at Belapur - Kharghar Navi Mumbai are committed to effectively support the transfer of technology.