

500keV Industrial Electron Accelerator

The 500keV DC accelerator, indigenously designed and developed by Accelerator and Pulse Power Division, BARC has been in operation at BRIT, Vashi for the last 18 years. Beam power at 3kW continuously for 8 hours was established way back in February 2001. Recently the operation of the accelerator at 5 kW power was demonstrated to ULSC-PA members in February, 2018.

The 500keV DC accelerator utilizes a 10stage, balanced Cockcroft-Walton multiplier scheme to generate the high voltage. The HV generator is housed in a pressure vessel of 1.1m OD and 1.75m height in Nitrogen gas at 6kg/cm² pressure. An inside view of the high voltage column surrounded by aluminium corona rings are shown in Fig.2. The multiplier unit currently receives the 30kVp-0-30kVp, 10kHz input from a transformer which steps up the output from a water-cooled triode oscillator. A 10 kV, 2A DC supply is used in this oscillator. The 3-phase, 415V input from mains is stabilized, regulated, stepped-up and rectified to obtain this variable 10kV, 2A DC output.

Three NEC make accelerating tubes accelerate the beam from a 5kV electron gun with LaB₆ cathode. A Turbomolecular pump and a sputter ion pump are used to evacuate the accelerating column and scan-horn to 10⁻⁶ mbar pressure. After acceleration, the beam is scanned at 100 Hz by a magnet made of CRGO silicon steel core and extracted to atmosphere through a 25 micron thick Ti foil cooled by forced convection.



500keV Electron Beam Accelerator

To keep pace with technology, a solid state inverter has been designed, developed and tested with the system and it will be integrated with the system shortly. The electrical schematic of the solid state oscillator to feed the Cockroft-Walton Multiplier. In the inverter scheme, a DC supply of 30-500 V will be switched by IGBTs to generate square pulses. With the help of a suitable tank circuit, it will be converted to sinusoidal pulses at 10 kHz and inverter output will be stepped up by a ferrite core transformer. In industrial electron accelerator, efficiency of converting mains electrical power to electron beam power is an important factor and it is likely to go up from 70 to 90 %



500keV Accelerator Multiplier Column

Electron beam generates bremsstrahlung x-rays when it impinges on the job. Radiation shielding is provided by 80 mm thick lead plates which enclose the accelerator and reduce the radiation to safe levels in the surrounding area. Wall-mounted Area monitor 351L of PLA make with radiation alarm setting has been installed with GM Tube and radiation survey is done during operation using AT1133 of make. The accelerator can be controlled from a user-friendly touch panel as shown in figure. The beam current and voltage can be set from the panel. The accelerator can start only if the following conditions are satisfied.

- i) Radiation area monitors are on
- ii) The shielding plates and blocks are in place.
- iii) Doors to the restricted area are closed
- iv) Scanning system is on with required current
- iv) Ozone blower is on
- v) Necessary vacuum has been attained in the beam- line.