

A.5: Performance of 6 MW peak power, 300 Hz, pulsed microwave system for 9.5 MeV, 10 kW electron Linac-3

A 6 MW peak power pulsed microwave system has been commissioned at IMA building for testing and qualification of 9.5 MeV electron Linac-3. The specifications of the microwave system are shown in Table A.5.1. The microwave system is based on klystron and powered by a line type, 130 kV, 90 A pulse modulator as shown in Figure A.5.1.

Table A.5.1 : Specifications of microwave system.

Parameter	Value
Peak output microwave power	6 MW
Average output microwave power	20 kW
Microwave frequency	2856 ± 5 MHz
Pulse width (FWHM)	11 μs
Klystron pulse voltage	-130 kV
Klystron pulse collector current	90 A
Pulse repetition rate	1 to 300 Hz
Pulse modulator type	Line type PFN based



Fig. A.5.1: PFN based line type pulse modulator.

High voltage and high power thyatron tubes are used as switching devices in this line type pulse modulator for command charging and discharging of pulse forming network (PFN) of modulator circuit. The PFN is charged to 20 kV voltage, using a high voltage DC power supply of 11 kV, by resonant command charging method. The output pulse of PFN is stepped up by a pulse transformer of ratio 1:13 to 130 kV and applied to the cathode of klystron tube. The klystron tube amplifies the input microwave to 6 MW output peak power.

Initially, the electron beam optimisation and low power beam tests were done. Subsequent to successful initial tests, beam power was increased up to 5 kW using this indigenously developed microwave system. The linac input microwave peak power was 4.8 MW and linac was producing ~9 MeV electron energy and 330 mA beam current. To reach the electron energy up to 9.5 MeV, more microwave power was required at the linac input.

Since the klystron tube was kept away from linac, ~20% power was getting lost in the long waveguide line. Therefore, to reduce the transmission losses, the klystron tube and its high voltage deck were shifted to linac vault as shown in Figure A.5.2. In this set up, the length of the waveguide line is reduced to 2.7 m. The peak power at linac input end got increased to 5.5 MW due to reduced transmission loss. In the new layout, the length of HV cable connecting the modulator and pulse transformer substantially increased. Due to increase in cable length, the shape of the klystron cathode voltage and microwave power was deteriorated and had ripples up to 10%. Suitable R-C filter has been provided at the pulse transformer end and tuning of pulse forming network was done again to get the flat top of microwave pulse within ±2.5%. Typical microwave pulse at linac input is shown in Figure A.5.3.



Fig A.5.2: 6 MW klystron with HV deck in linac vault.

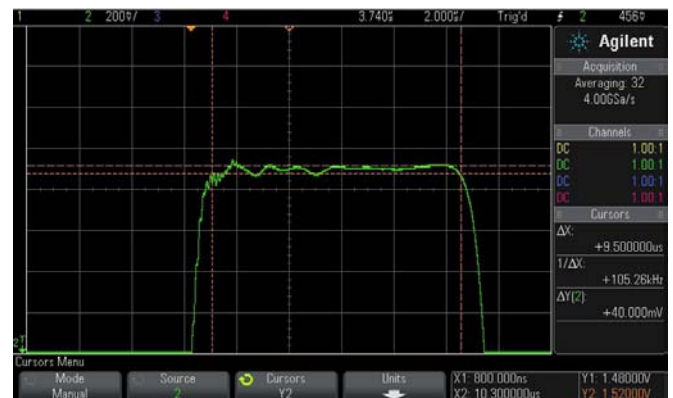


Fig. A.5.3: 5.5 MW microwave power pulse at linac input end.

The electron beam energy of 9.5 MeV and current of 400 mA is obtained from the linac. Two non-stop 8 hours operations of linac at 300 Hz pulse repetition rate (PRR) have been carried out and average beam power output of 9.5 kW has been achieved with this microwave system.

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