

A.4: High power testing of Linac-3

Linac-3 (9.5 MeV, 10 kW average beam power) is designed for food irradiation and has an energy limiting system to remove electrons above 9.95 MeV in electron beam mode to meet the regulatory requirements for food irradiation. Linac-3 was assembled last year and tested at 1 kW beam power. Several modifications were carried out in Linac-3 for testing at high beam power. Low emittance gun was developed for smaller beam size and improved beam transmission through complete linac. The new e-gun was assembled and tested on test stand as shown in Figure A.4.1 before its integration with linac.



Fig. A.4.1: Characterisation of low emittance gun on test stand.

Low-energy beam transport (LEBT) line was compacted to reduce emittance growth. Klystron was shifted inside linac vault for increasing peak power delivered at input RF coupler. Water cooled apertures were assembled before 270° magnet to ensure the position and divergence of injected electrons. Magnet pole gap was increased to 34 mm and new vacuum chamber with 24 mm aperture was assembled. Linac-3 assembly is shown in Figure A.4.2.



Fig. A.4.2: Linac-3 assembly under high power test.

With these modifications, linac trials were started and beam transmission greater than 90% was achieved through energy limiting system. Beam power was increased by increasing pulse repetition rate (PRR) in stages and settings of focusing coils, steering coils and 270° magnet were optimized to maximize transmission through the linac. Several trips were encountered during initial stages of high power testing. The trips were analysed and measures were taken to reduce the frequency of trips.

High power operation at beam energy 9.5 MeV and beam power 9.5 kW has been established. Typical beam parameters during the test are shown in Figures A.4.3 and A.4.4.

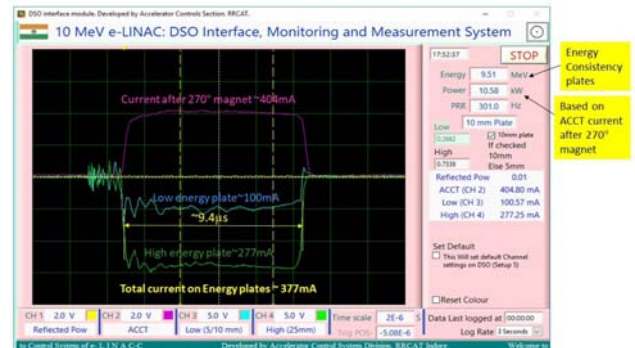


Fig. A.4.3: Screenshot showing beam current and energy.

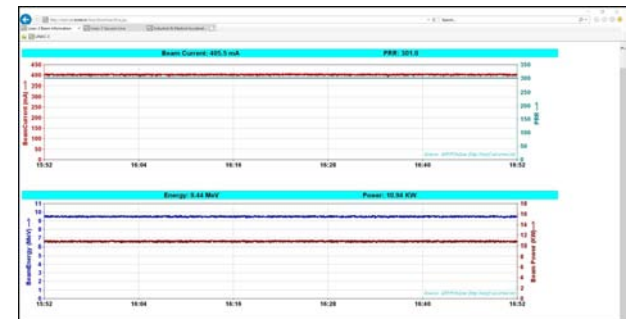


Fig. A.4.4: Plot of beam energy (blue), current (red) and power (maroon) after 270° magnet for one hour duration.

After achieving steady and stable operation at 300 PRR, two non-stop operations of 8 hours at beam power of ~9.5 kW have been completed in March 2021 as shown in Figures A.4.5 and A.4.6. Further testing of Linac-3 and dosimetry qualifications are planned in the coming months.

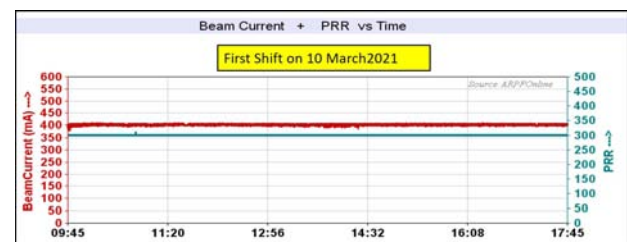


Fig. A.4.5: Beam current plot during first non-stop eight hours shift.

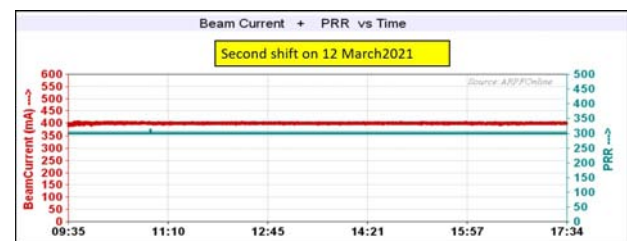


Fig. A.4.6: Beam current plot during second non-stop eight hours shift.

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