A.1: Development, testing and integration of new 20 MeV injector microtron

A new 20 MeV injector microtron with improved features has been developed, tested and integrated as a new injector for Indus accelerators (Fig. A.1.1), replacing the old microtron.

Fig. A.1.1: New 20 MeV injector microtron in Indus Accelerator Complex

Table A.1.1: Main design parameters of the new microtron

Parameter	Value
Beam energy	20 MeV
Pulse beam current	20 mA
Magnetic field	0.1780 T
RF cavity frequency	2856 MHz
Number of orbits	22
Pulse width	0.5 μs
Pulse repetition rate	1 Hz
Vacuum	2 X 10^{-7} mbar

The main design parameters of new microtron are listed in Table A.1.1. The improved features include design for highly repeatable assembly, stringent control on geometry and material properties during manufacturing, beam extraction mechanism with 2-D motorized control, provision for cathode observation in operation, better vacuum conductance, multi-port diagnostics for magnetic field, rigid support structure with sliding trolley for magnet pole opening, etc. The microtron magnet assembly was manufactured by M/s Godrej and Boyce Pvt. Ltd. Mumbai as per RRCAT specifications and supervision. Various subsystems such as microwave, power supplies, control, beam diagnostics, cooling, vacuum, magnetic coil elements have been developed by expert groups at RRCAT. The microtron was assembled in E-1 accelerator test vault of IMA Building along with its subsystems. Magnetic field uniformity of dipole magnet was measured to qualify the magnet assembly, and the accelerator test infrastructure was established in the test vault for the beam testing. Approval of AERB was obtained for beam testing. The 20 MeV beam was achieved in a short time after starting the trials. The microtron was further tested for beam repeatability after several openings of the magnet assembly. After each opening and re-assembly, the rated beam was obtained in a short time. The installation of the microtron was planned in considerable details as this required a long shut-down of the Indus facility. The new microtron was installed, commissioned, integrated after removing the old microtron in about seven days of intensive effort by a very large multi-disciplinary team. For validating the suitability of the new microtron with booster, it was operated and beam filling was undertaken in the booster. A beam current of 5 mA was obtained in a short time in the booster (450 MeV) and thereby the injector's functionality was validated. The Indus facility has worked smoothly for more than 1000 hours since 22nd April 2017 in round the clock mode with the new microtron. A large number of expert teams from IAD, PHPMD, AMTD, ACSD, PCD, PPSD, IOABDD, UHVTS, DMTD, APS, CTF, and HPU worked on this development. Performance of the new microtron is summarized in Table A.1.2.

A beam waveform during the operation is shown in Fig. A.1.2.

Table A.1.2: Performance of the new microtron

Date	Beam current			
	Microtron 20 MeV	Booster 450 MeV	Indus-1 450 MeV	Indus-2 2.5 GeV
11.04.17	20 mA	6.5 mA[1]		
27.05.17	18 mA	4 mA	125 mA	178 mA
14.07.17	19 mA	3.4 mA	100 mA	204 mA

[1]*Beam trials immediately after integration.*

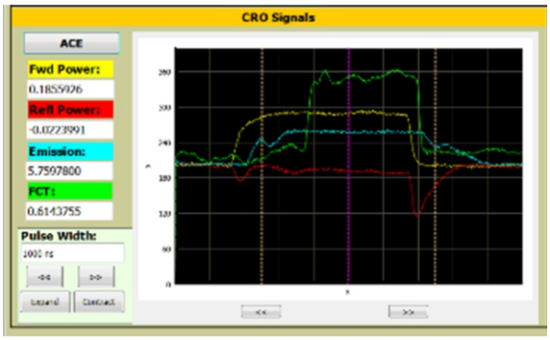

Fig. A.1.2:Beam waveform (green)

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