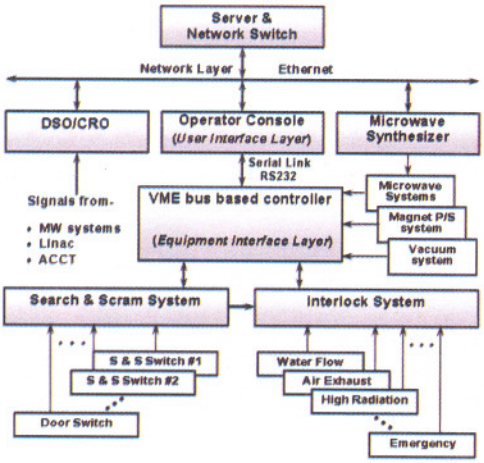
A.14: Control System for Linac for Agricultural Radiation Processing Facility

A Linac based Agricultural Radiation Processing Facility (ARPF) is being setup by RRCAT for irradiation of agricultural products. Being a radiation facility, remote control system is a mandatory requirement for monitoring and control of the Linac and associated subsystems. Most of the subsystems and the critical interlocks are located in inaccessible or restricted areas. Human safety and safe operation of the Linac and subsystems are of prime importance. Considering all these aspects, the control system for the Linac is developed by Accelerator Control Section (ACS). Monitoring and controls of diversified subsystems, timing trigger system, instruments and machine and personnel safety interlocks are some of the main features of the control system. Scheme of the control system is shown in Fig. A.14.1. The control system is distributed over the hardware and software layers. Subsystems and interlocks are supervised directly in hardware in the Equipment Interface (EI) layer. The User Interface (UI) layer plays a role of Supervisory Control And Data Acquisition (SCADA) implemented in LabView. Communication between instruments and the data exchanges between programs is managed by third layer, the Network (NW) layer.



FigA.14.1: Scheme of control system ARPF Linac

The control system is a centralized supervisory control system made around the VME bus based controller having MC68000 processor based CPU and digital and analog I/O boards developed in ACS. It is a modular control system. Every subsystem is directly connected to the control rack. Isolation is provided in each interface signal.

The control system supervises the subsystems using digital inputs for reading status like On/Off, Local/Remote etc., digital outputs for controls like On/Off, Reset etc, analog inputs for readbacks, and analog outputs for settings. Some of the supplies are directly connected to the CPU over RS485 serial interface. Generation of reference waveforms for scanning magnet power supply is also a feature of the control system. The VME controller is connected to the console PC using RS232 link. The control system is also equipped with an interlock module. It has provision for 24 interlock inputs. All interlock inputs are taken in failsafe mode. If any of the interlocks fails, necessary control action is taken in hardware itself. This ensures safety of the Linac and subsystems. Personnel safety is ensured by the "Area Search" interlock from Personnel Safety System module. The status of interlocks is also displayed on the console.

For better performance in the electrically noisy environment, isolation is provided in all interface signals between control system and the subsystems. All I/O signals are isolated on channel to channel basis to avoid formation of ground loops or common coupling loops even between two subsystems. Digital I/O signals are isolated using opto-isolators and relays. Analog isolation amplifiers are used in each of the analog I/O channels. Output stages of the iso-amplifiers are powered by using isolated forward converters. Both RS232 and RS485 interfaces are also of isolated type to reduce the possibility of ground loops formation through serial link returns paths. This also reduces the chances of EMI and common mode interference.

Control S/W is developed in assembly language of MC68000. The S/W is modular. GUI at operator console and dedicated software to control various instruments are developed in LabVIEW. A web site is also developed to locally display the historical data of beam current and beam energy. Along with this, the data logging of various parameters and retrieval of tthe same is also provided.

Linac is being operated using the control system. Figure A.14.2 shows graph of a typical day long operation. It is taken from the stored data in database.

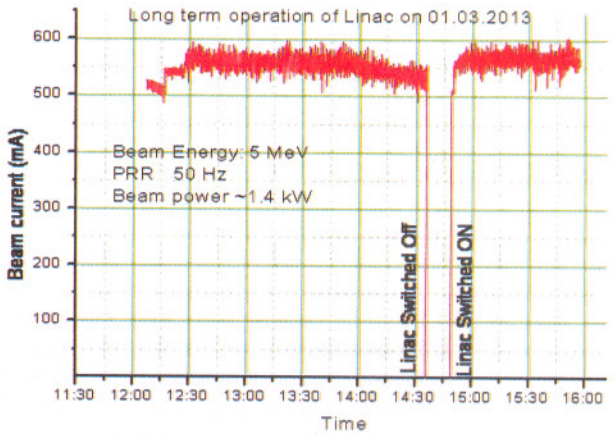


Fig A.14.2: Operation of Linac on March 1, 2013

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