CONTROL SYSTEM FOR AN INDUSTRIAL ACCELERATOR TECHNOLOGICAL COMPLEX.

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This paper deals with the control and protection system for an electron linac for industrial purposes (KYT). The KYT is a powerful source of accelerated electron beam and is designed to be used for radiation processes including sterilization of medical supplies. KYT was designed and constructed in KFTI. The pilot KYT has been operating since September 1993. This linac produces a 8-10 MeV electron beam with a power of up to 10 kW. The commercial production of KYT was started in 1994. A description of the system ispresented.

HARDWARE AND TECHNICAL SUPPORT

The linac includes the high-voltage generator, the electron source, the accelerating system, a klystron with its high-voltage modulator and a scanning and electron beam extraction device. The control system provides the beam current and energy monitoring, the control of system parameters and fault diagnostics of the linac units, the protection for the accelerator system against damage by the beam, interlock protection for the modulator and klystron amplifier against incorrect operation, regulation of the currents in the magnet power supplies, regulation of the phase and power of the RF system, control of the irradiation dose at the target and monitoring of target transportation system.

The layout of the system is shown in figure 1. The hardware consists of a personal computer equipped with analog-to-digital converters (ADC). This is connected by a local area network to the units shown below, which are situated about 40 m from the PC. There is a synchronization unit (SU) and three microprocessor controlled units: one for the klystron amplifier modulator (KAM), one for the technical services (TS), and one for the target transportation system (TT). The control system of the experimental model of KYT was made using the CAMAC standard [1]. However, this was too complicated for industrial usage, so the new version of the system will not use CAMAC.

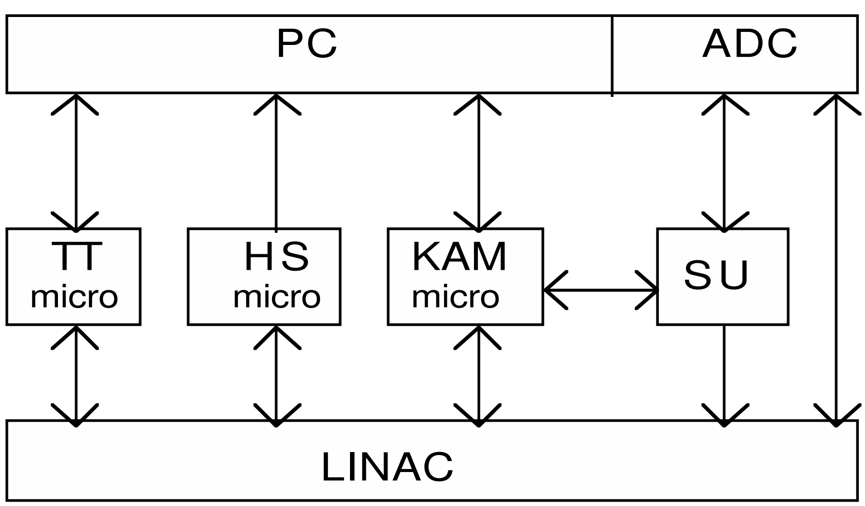

Fig. 1. Schematic of the control system.

The ADC units receive signals from analog pulse detectors. They have two switched channels with 100 ns period and two integrating channels. The SU assigns time-dependent programs to the pulse generation system, the control system subunits and the measuring equipment. The linac operation frequency can be selected within the range of 25 - 300 Hz, while in emergency situations or during a bean commissioning run it can be lowered to 6.25 Hz. Switching on the SU automatically brings back the operation regime which was in use when the SU was previously turned off.

The KAM unit monitors the operation of the klystron modulator, ensuring the interlocking of the HV-supply and beam switch-off, when the accelerator equipment enters into a hazardous state of operation, or when its operation becomes dangerous for service personnel. This unit controls about 60 digital and analog signals.

The HS unit controls the operation of two cooling and three precise temperature controlled water circulating systems, monitors the temperatures in the accelerator main components and the water flows in the cooling systems, using thermocouples and sensors. The TT subunit controls the magnetic elements of the accelerator and the target transportation system.

SOFTWARE AND PROGRAMMING

The program package CSL (Control System Linac 1.2), written in C, provides for the CS operation in three stages:

- linac switch-on and -off,
- parameter variation and control,
- automatic control, identification of any deviations from the assigned operation parameters and monitoring of the irradiation process.

Information on the system operation and the electron beam parameters is fed to monitors on the local control panels at each of the subunits TS, KAM, SU, TT, and to the color graphics three-screen display at the main control console. Control of the accelerator operation can be carried out either by the operator at the main console PC keyboard, or from the local control panels. For each of the 16 main accelerator systems there is a corresponding overlay module in the CSL, called by the basic monitoring software. These program modules allow the operator to monitor single or multiple systems parameters, to give commands, to save and view archive files, to control the radiation dose, to control the transport system for the articles being irradiated, etc. Parameters of several systems can be monitored simultaneously, but only sone ystem can be regulated at a time.

CURRENT STATUS AND PROSPECTS

At the present time different versions of the system described above are working at two accelerator complexes. Two new KYT-2 accelerators which are now being manufactured will be supplied with similar systems.

REFERENCE

1. V.N.Boriskin et al. Control system for a linear resonance accelerator of intense electron beams / Nucl. Instr. and Meth. in Phys. Res A 352 (1994) 61-62.