RESEARCH OF MODIFICATIONS OF A BEAM AND SIGNALS PARAMETERD IN TECHNOLOGICAL LINACS

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The power current pulse linacs of electrons are used in the Science Research Complex "Accelerator" at NSC KIPT for irrradiation of materials and some products. The irradiation sessions usually last tens of hours. Some results of the linac parameters for this period are given in the present paper. The research was performed at the one- section linac KUT and the two-section linac EPOS. Their beam energies are not more that 12 MeV and 30 MeV, respectively. The operation linac frequencies are in the range of 150…. 300 Hz, pulse beam current is not more than 1 A. The technological object zone irradiated by accelerated electrons is created with the magnet scanning system [2].

The beam parameters are measured with the automatic control system [3,4]. The form and value of the pulse beam current (I) is measured with the magneto inductance transducers [5].

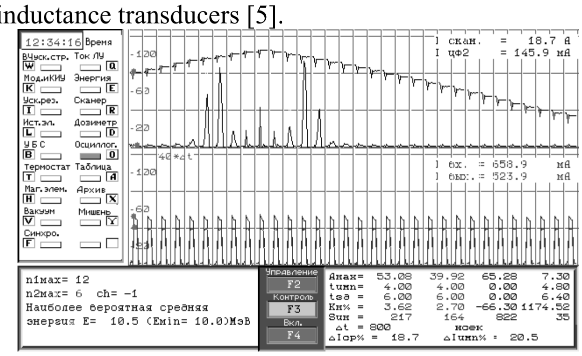

Fig. 1. Videogram of the process of the electron beam energy and beam pulse current control at the linac KUT 08.18.99.

The amplitude and average current values are evaluated in response to a sensor signal by the control system (Fig.1). The average value of the sensor signal amplitude were computed with the sample of N=32 pulses to reduce the effect of an interference. If the sample is more than 32 pulses, average estimated value (Iav) is practically unchanged. (Fig. 2).

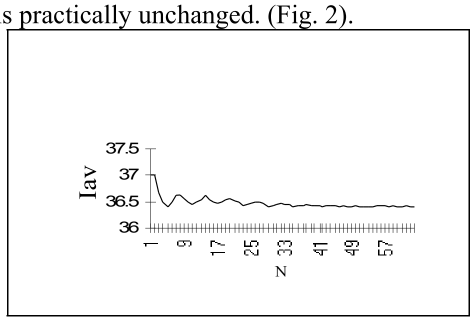

Fig.2. Convergence of the evaluation of the Iimp average value at the accelerator complex output (5.12.97).

The spontaneous changes of pulse current amplitude that were observed for few hours run lay within ± 10 % (Fig.3).

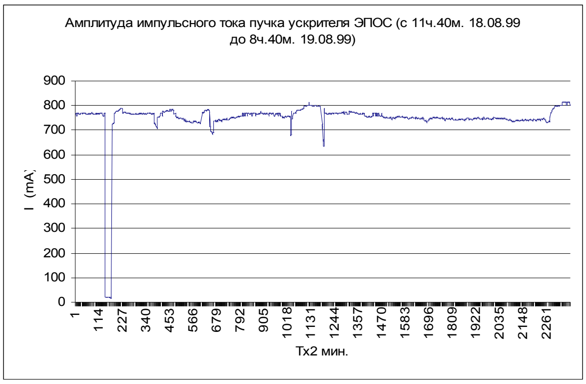

Fig. 3. EPOS linac pulse current amplitude (08.18.99 11:40 – 08.19.99 8:40).

In [7, 8] it was shown that the scanning electromagnet equipped by a beam position sensor may be used for the on-line control of the electron energy. The wide-aperture (50 x 200mm) magneto-induction position transducer is used for the energy and position control of the sweeped electron beam at the EPOS exit [7]. On the KUT linac the slot hole Faraday cylinder [8] is used for this purpose. One of the system modules provides the simultaneous signal measurement from the sensor winding and the scanning magnet excitation current – I_s (fig.4). Results of measurements of several scanning cycles were used to calculate the maximum Y_{max} and minimum Y_{min} values of the electron beam center deviation and to determine the value $R= Y_{max} - Y_{min}$ and E=f(I_s,R). The spontaneous changs of average electron energy that were observed for few hours run lay within 10 ± 1 MeV (KUT linac) and 21 ± 2 MeV (EPOS linac).

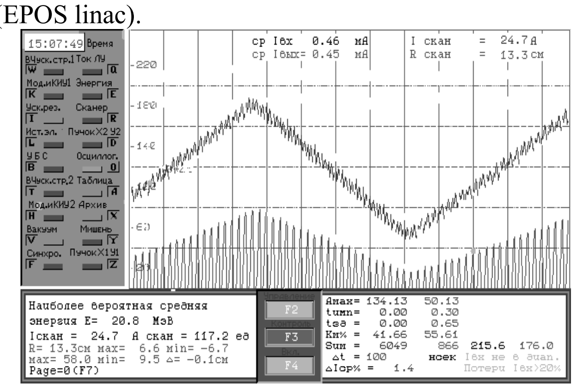

Fig. 4. Videogram of the process of the electron beam energy control on the linac EPOS.

The EPOS linac is also equipped with four winding position sensors. These sensors enable one to measure the center beam position (X, Y) with 0.5 mm error and to evaluate the asymmetry of the beam form in the cross-section ($\sigma^2x-\sigma^2y$) [9]. The center beam position changes observed for twelfth hours were not more than ± 1.5 mm and asymmetry changes were ± 5 mm^2 (Fig.3).

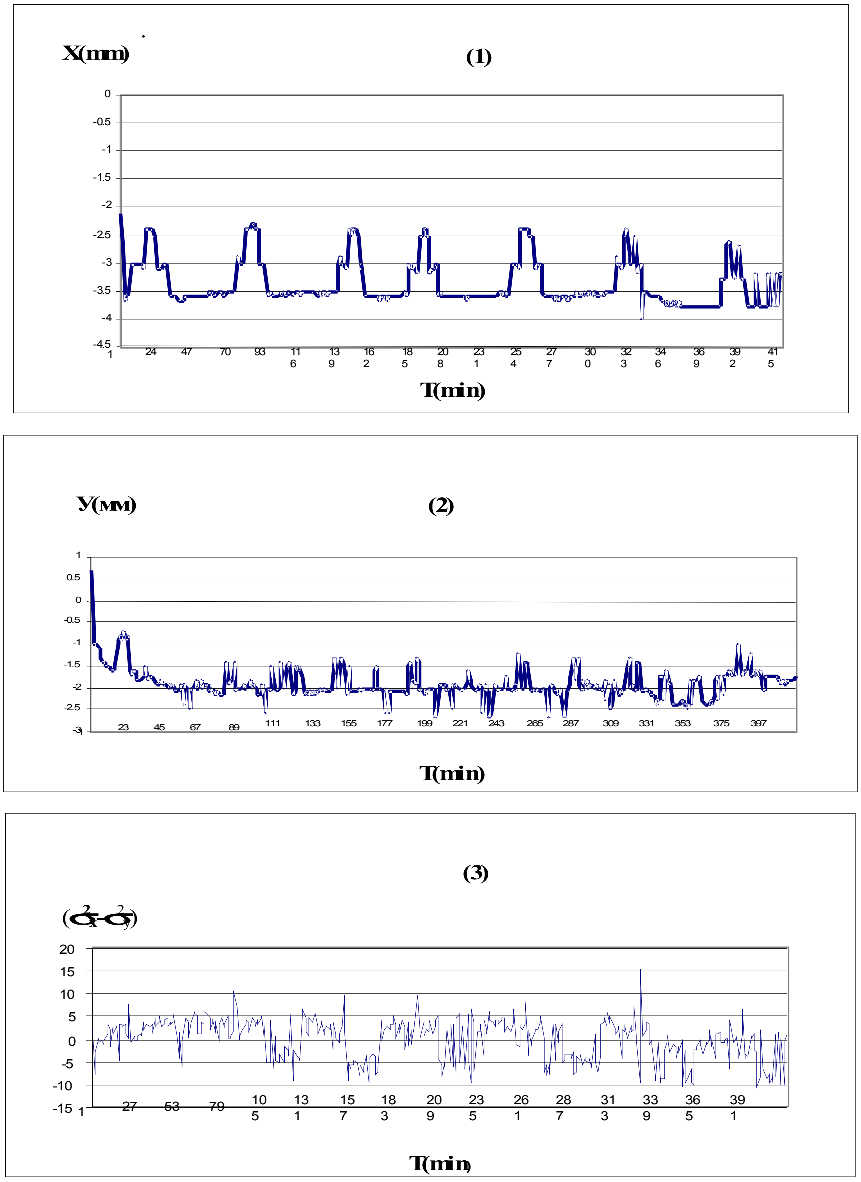

Fig. 5

1. Change of the center beam position by X on exit of the EPOS second section.
2. Change of the center beam position by Y on exit of the EPOS second section.
3. Change of the beam cross-section asymmetry on exit of the EPOS second section.

E=21MeV, I_{pulse}=0.68 A (02.10.99 12:40 – 09:00)

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