Implementation of the radiation-resist automation system for BNCT

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The automation system is an integral part of the neutron-generating accelerator for Boron Neutron Capture Therapy. In the BNCT Laboratory of the Budker Institute of Nuclear Physics tests on cell cultures *(in vitro)* and mice *(in vivo)* were conducted, which showed the effectiveness of therapy. Next step is to prepare the facility for conducting clinical trials on humans. An important part of the therapy is the creation of a reliable automation system consisting of a set of nodes and operating under conditions of a high radiation hazard. The presence of neutrons and gamma radiation is a complicating factor in therapy and experiment, because under such a flow of ionizing radiation most of the equipment fails. This paper will present various configurations of the automation system that minimize the effects of ionizing radiation. The accelerator has an outdated automation system in which different nodes of the accelerator (ion source, accelerator, bending magnet) are controlled by different programs, which makes the nodes synchronization difficult. In this paper, the author will describe some steps to connect the nodes into a single system and implement the first version of a single database of experiments, which simplified the analysis of experimental data. It is necessary to modernize the automation system from experimental equipment to industrial blocks certified by the manufacturer. A comparative analysis of various control units and programming languages was carried out. Various installations and complexes were visited, such as: Kyoto University Research Reactor (Japan), National Cancer Center (Japan), University of Tsukuba Hospital (Japan), TAE Technologies (USA), prototype of 1 MW ion source H^- (BINP), ELV accelerator (BINP), VEPP-2000 (BINP), GDT (BINP). Based on the experience of visited experimental and industrial facilities, automation equipment was selected and it have already been purchased and embedded into the existing automation system. The implemented diagnostics have already helped to improve the conduction of the beam to the center of the lithium target through the entire vacuum path with visual diagnostics of the beam position on the way. Realized and planned upgrades will allow to conduct human clinical trials at the Budker Institute of Nuclear Physics.

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