

MITEV-1: The BNCT Development Project at the Institute for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences

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Introduction: The development of beam tube for Boron Neutron Capture Therapy (BNCT) - a promising radiation therapy for cancer tumour treatment, is one of the main objectives of the refurbishment of the research reactor IRT-Sofia of the Institute for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences (INRNE-BAS). BNCT is considered as one of the most important IRT-Sofia application significant for its future sustainable utilisation. The BNCT development at INRNE-BAS utilizes two parallel processes- (1) design of the BNCT facility and (2) building of scientific capacity and the accompanying infrastructure, necessary for successful implementation of the therapy. The BNCT is developed partly under support of the Bulgarian National Scientific Fund by the project NIK-2/2007 for creation of BNCT information system, and further by project D002-58 for BNCT infrastructure development.

Used approach: Extensive modeling of the geometry and material composition of the BNCT channel is being performed. The channel follows the beam tube configuration of the Massachusetts Institute of Technology Reactor and takes into account an ability to include the tube into IRT reactor geometry. The results of neutron and gamma transport calculations performed for the model have shown that the facility, built at reactor of low power of 200 kW will be able to supply an epithermal neutron flux of about $5 \cdot 10^9$ n/cm²s, with beam quality, which is well beyond the recommended values in IAEA-TECDOC-1223, and close to the best value reached in the world until now.

The organizational activities performed in parallel to the beam design are directed to smooth entering into BNCT application. Extension and enhancement of the BNCT engaged specialists' interdisciplinary team in close collaboration between the INRNE-BAS, the Medical University in Sofia, the Medical University in Varna, the Institute of Electronics of the Bulgarian Academy of Sciences, and the Faculty of Physics of Sofia University, the knowledge renewing and educating of human resources for BNCT, is a continuous process that forms the BNCT infrastructure. The Bulgarian National Cyclotron Center with attached radiochemical and biological laboratories, which is under construction at INRNE-BAS, will bring important scientific infrastructure for boron carrier pharmacokinetics in small animals and other BNCT related research. BNCT information system is created and is updating continuously. It contains already more than 460 papers on all aspects of BNCT. The information system includes INRNE-BAS reports and papers on BNCT as well. Additional research is envisaged in the coupling of optical and nuclear methods for diagnostics, localization, monitoring and therapy of malignant tumors, mainly by combining the advantages of the Photo Diagnostics Analysis and Photo Dynamics Therapy with BNCT.

Our specialists have participated in important international BNCT forums, establish new and keep on going already established contacts with experts from other BNCT facilities at High Flux Reactor at JRC-IE, Petten, the FiR-1, Finland, the Massachusetts Institute of Technology, USA and the MEPhI IRT Reactor, Moscow, Russia. The accumulated knowledge, skills, information for the installation and activities needed for BNCT realization are permanently analysed and refreshed. A special session devoted to nuclear application in medicine with accent on BNCT was organized in the frames of the conference of Bulgarian Nuclear Society to assess the interest of the Bulgarian nuclear medicine community and gathered many oncologists and physicists. Specialists from Japan, Romania, Germany and Bulgaria exchanged their intentions and experience in BNCT during the meeting.

Poster, TV and radio presentations oriented to BNCT method of treatment are being organised to keep in touch the public at large.

Conclusion:

The optimization of BNCT beam tube design for a low power IRT reactor is in its final stage. Extensive information which is necessary for taking decisions on the most efficient way for performing BNCT is available. Significant activity is performed for ensuring the necessary scientific infrastructure and human resources. The Bulgarian National Cyclotron Center will provide important new accelerator based scientific tool that will become available for BNCT related investigations in the area of pharmacokinetics and microbiology in the near future.