

A new plant design for reactor PIK heavy water detritiation

S.D. Bondarenko*, I.A. Alekseev, E.A. Arkhipov, O.A. Fedorchenko, K.A. Konoplev,
T.V. Vasyanina

Petersburg Nuclear Physics Institute, 188300, Gatchina, Leningrad district, Russia

The construction of high-flux research reactor PIK with heavy water reflector is nearing completion in Petersburg Nuclear Physics Institute. The reactor PIK should be supplied with Detritiation Plant (DP) to remove tritium from heavy water in order to reduce operator radiation dose and tritium emissions.

The original design of the reactor PIK Detritiation Plant was accomplished almost twenty years ago. To satisfy new safety requirements, introduce new technology and equipment, use results of recent investigations and reduce the cost of the plant, the project of DP has been revised. The main task of DP is removing of 1100 TBq of tritium and 40 kg of light water per year from the heavy-water reflector. Tritium content in heavy water has to be maintained at the level of 74•GBq/kg D₂O, and the deuterium content - not less than 99.8 at.%. Besides, DP has to be able to process heavy water waste producing heavy water with reduced content of tritium (less than 10⁵ Bq/kg).

New process flowsheet of DP has been developed. Engineering design is in progress. In contrast to original design, where a big cryogenic distillation column (CD) does all isotope separation work, in our new design Combined Electrolysis and Catalytic Exchange (CECE) process undertakes the main part of this work. CECE system not merely removes protium and depletes heavy water in tritium but does preliminary (up to ten times) concentration of tritium also. A small cryogenic distillation column is used only for end raising of tritium content in deuterium gas before send it to the final storage on titanium bed. So the values of circulation flows, the size of CD and auxiliary equipment, the capacity of refrigerating decrease dramatically.