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Analysis of the SVBR-100 nuclear fuel cycle by means of the advanced nuclear fuel cycle assessment methodology (ATTR)

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Commissioning of small modular reactors (SMR) seems to be the most reasonable option for the majority of countries embarking on nuclear energy. According to a number of IAEA publications, more than 45 different projects of small nuclear power plants are currently under development and implementation. Russian technological experience with nuclear propulsion systems for navy and ice-breaking fleet is currently implemented for development of SMRs for electricity and heat supply.
One of such SMR is SVBR-100 with chemically inert coolant based on Pb-Bi, which can reduce the probability of severe accidents. It guarantees the increased resistance to certain equipment failures, human errors and voluntary actions. However, high initial enrichment of SVBR-100 nuclear fuel (average enrichment is 16.5% for current SVBR option) and weapon-grade quality of plutonium produced reduce the proliferation resistance characteristics of its fuel cycle. This is particularly relevant for the promotion of such reactors to the markets of the embarking states.
Enhancement of SVBR-100 nuclear fuel cycle proliferation resistance is possible by means of involvement of nuclear fuels based on reprocessed uranium. The following table shows the dependence of changes in the plutonium isotopic vector at the moment of fuel discharge. As one can see, the initial content of 236U even isotope leads to the increase in 238Pu (reduces the attractiveness of fissile materials from the perspective of non-proliferation, source of neutrons with spontaneous fission and high energy release).

Involvement of reprocessed uranium in the SVBR-100 nuclear fuel cycle aside from mitigation of risks of proliferation leads to the formation of synergistic effect. This effect is expressed in minimizing of spent nuclear fuel of thermal reactors, saving of uranium resources as well as boosting the competitiveness of such reactors in organizing supplies abroad.
The present report provides the analysis of nuclear fuel cycle of NPP's with SVBR-100 reactor type using the advanced nuclear fuel cycle assessment methodology (ATTR) to ensure non-proliferation of fissile materials and to assess the consumption and saving of uranium recourses by means of IAEA software.

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