For how long will mankind have enough fissile material under the various scenarios of the development of nuclear energy?

Date : November 16, 2017

This will be determined by the choice of nuclear fuel cycle options. With the adoption of an open or closed uranium NFC run on thermal reactors burning "rare" uranium-235 (0.71% in the natural mixture of uranium isotopes), nuclear power generation shall face a shortage of resources that could be profitably mined as early as by the middle of this century. This will cause a gradual, natural decline of the nuclear power industry and its virtual disappearance by the years 2080 – 2090. Using recycled plutonium in MOX fuel composition can postpone the decline only for another 15-20 years. A more optimistic scenario envisages large-scale inclusion of thorium in NFC; deposits of this element on Earth are 3-4 times higher than that of uranium.

By optimizing organization of the thorium fuel cycle with burning uranium-233 produced from thorium-232 in thermal reactors, nuclear power generation can be brought to a replenishment level, but even then it’s a long way off before the nuclear power generation shall be able to meet increasing power demands of mankind. The situation can be changed dramatically only if the NFC incorporates fast breeder nuclear reactors (breeder reactors) running on plutonium-239 fuel. They produce more plutonium-239 from non-fissile uranium-238 than the amount that they consume. This allows, firstly, the use of uranium-238, almost excluded from the open fuel cycle and, secondly, most effective use of available and stockpiling plutonium reserves in the fuel cycle.

Proper organization of the nuclear fuel cycle with an optimal combination of thermal nuclear reactors and fast breeder reactors shall meet the growing energy requirements of mankind for thousands of years.