ABSTRACT

Currently, nuclear power in Russia is based on thermal neutron reactors of VVER and RBMK types. In Russia, 29 power reactors ensuring total installed power of 21.2 GW(e) are now in operation. Nuclear power units' contribution into the net electricity production amounts to about 12%. All nuclear power units including fast neutron reactor BN-600 use uranium fuel. Annual spent fuel discharge amounts to about 800 t which contains about 4 t of plutonium and 0.3 t of minor actinides.

Power development in Russia up to year 2010 is determined by the document "Power Strategy in Russia" approved by the government. In this document, nuclear power has been defined as a necessary part in the whole power system of the state. In Central, Western, and Far Eastern parts of Russia, nuclear power has definite economic advantages in comparison with coal and even natural gas-based power. Specific situation with nuclear power in Russia consists in the fact, that during nuclear activity in the past, large stock-piles of uranium resources have been accumulated. These resources allow to develop nuclear power up to more significant level by year 2010 as it has been planned. At the same time, because of collapse of the Soviet Union, it is occurred that natural resources of uranium in Russia is not so large as it was in the former Soviet Union. From this point of view, one should be very careful when making prognosis for nuclear power in Russia for long-term period. As to short-term period, the expected level of nuclear power in Russia will increase slightly versus contemporary one. Up to year 2010, the main works in nuclear industry are to update existing nuclear units and decommissioned units are to be substituted by nuclear reactors with increased safety features.

To determine the possible level of development of nuclear power and its structure, many factors are to be analyzed. It is worth the following to be mentioned:

- Existence of natural uranium resources and their limits;
- Industry development level including nuclear industry branch;
- Availability of up-to-date nuclear power plant designs with improved safety features;
- Country's ecological safety and people health protection;
- Economic indices for competition with conventional power.

Taking into account these factors, the level of nuclear power technology and Russian territorial features, economic studies should ultimately answer the following questions: What
contribution of the nuclear power can or is to be in the country and what is its optimal structure?

In this paper some elements of these vast studies are described. In the studies expected assessments of nuclear power development were carried out using natural criteria of the existing uranium resources; and nuclear power structure consideration was aimed at the balancing of excess plutonium amounts, minimization of natural uranium requirements and minimization of radiotoxic wastes. Some results gained in these studies are presented below.

The following scenario of nuclear power development was considered. By the year 2010 a nuclear power level of 32 GW(e) is supposed to be reached. As for time period 2010-2030, the authors of the study have considered two options of development, in which nuclear power reaches 50 GW(e) and 80 GW(e) of installed electrical capacity by the year 2030, respectively.

Judging from the obtained results one can conclude that real nuclear power development in Russia can not exceed 50 GW(e), and that is under conditions that after the year 2030 replacement of the decommissioned units will be performed by fast reactors only which do not require enriched uranium.

It needs to be emphasized, that the conclusions obtained, have been made with no account for the world uranium market and at the condition of fixed uranium resources. Uranium purchases in other countries and exploration of new uranium deposits on Russian territory can essentially change the results.

On the other hand, a question arises. Is there sufficient amount of plutonium in Russia to put into operation the necessary number of fast reactors? Yes, currently an excess of separated plutonium exists, so far as it hasn’t been required for the nuclear power development purposes. But if nuclear power in Russia is supposed to be expanded, to support its capacities all amount of plutonium will be needed. In this case even plutonium shortage could take place, and it could slow down the realizations of nuclear power development plans.

Various options of nuclear power structure consisting of existing VVER-1000 thermal reactors and BN-800 fast reactors, have been analyzed.

It has been shown, for instance, that successive single plutonium and uranium recycling in thermal reactors reduces natural uranium requirements by a factor 1.4 as compared with the once-through cycle of these reactors and the amount of radioactive wastes including plutonium decreases in this system by a factor 3 in the same comparison.

The minor actinides problem can be solved by the joint use of thermal and fast reactors. In this case plutonium and minor actinides multirecycling results in radically new situation when uranium, plutonium and minor actinides will be «closed» in the cycle and their release into the environment will be insignificant, only as inevitable losses from technological operations in chemical processing. Thus, nuclear wastes of the systems including fast reactors will consist mainly of fission products, that is 25-50 times less than the amount of radioactive wastes for the once-through fuel cycle.