RBEC LEAD-BISMUTH COOLED FAST REACTOR: REVIEW OF CONCEPTUAL DECISIONS

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A concept of the RBEC lead-bismuth fast reactor-breeder is a synthesis, on one hand, of more than 40-year experience in development and operation of fast sodium power reactors and reactors with Pb-Bi coolant for nuclear submarines, and, on the other hand, of large R&D activities on development of the core concept for modified fast sodium reactor with extended breeding of nuclear fuel as well as on development of the technical project of the heterogeneous core of BN-1600M reactor.

The main aim of the RBEC development was to demonstrate the possibility to combine existent advantages of each reactor technologies in one nuclear power facility to improve economic and breeding parameters compared to reactors of BN-type with simultaneous safety enhancement and environmental acceptance due to application of heavy-metal coolant.

Design and technological decisions experienced in practice and checked experimentally became the basis of the RBEC design:

- *wide fuel rod lattice*, allowing to reduce hydraulic resistance in fuel assemblies; to increase the coolant natural circulation level; to use fuel assemblies without shrouds; to decrease fraction of steel in the core and, thus, not only to improve core breeding ratio (CBR), but also to create conditions for reducing the void reactivity effect;

- *in-assembly heterogeneity*, allowing to increase effective fuel density in the core without development of new types of mixed fuel; to obtain CBR about 1; to increase fuel burnup without increase of neutron fluence;

- *high-density carbide fuel* in fertile rods with low linear rating power and burnup, not requiring filling of fuel-clad gap with liquid metal;

- *parameters of turbine circuit experienced in the nuclear power*, allowing to use design decisions for steam generator and turbines checked in practice.

The use of lead-bismuth coolant at low heating-up in the core and outlet temperature allows to use 12%Cr ferrite-martensite steels resistant against radiative swelling and radiative creep. Corrosion resistance of this fuel clad material was checked in practice for these temperatures with the use of special technological processes of oxygen concentration maintenance in the coolant.

On our opinion, if during the nearest 10-20 years creation of fast reactor with heavy-metal coolant is required to demonstrate advantages of such reactors in economics, breeding properties and inherent safety, then one of the best projects from viewpoint of feasibility and provision of mathematical modeling for serial and accident conditions will be a reactor of RBEC type.

The report briefly reviews main parameters of the RBEC reactor, as a candidate for commercial exploitation in structure of the future nuclear power, in comparison with traditional sodium fast reactors and other advanced projects of heavy-metal reactors.