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”Peculiarities of behavior of Coated Particle fuel in the core of Fast Gas Reactor BGR-1000”

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Fast Gas Reactor BGR-1000 with thermal power of 2 GW is cooled with high-pressure helium (16 MPa), heated in the core from 350 to 750oC. In a steam generator of the power conversion system the thermal power is transferred to the SCW-coolant of secondary circuit, which goes to the turbine with pressure of 30 MPa and temperature of 650oC. Reactor core contains Fuel Assemblies (FA) having perforated shrouds. FA’s inside cavity among shroud, control rod guide tubes and central perforated collector is filled with pebble-bed of micro-fuel coated particles (CP). Helium coolant goes into FA through the perforated shroud, passes over CPs removing heat from them and goes then to the FA outlet collector through its perforated wall. The mix-carbide fuel UPuC with mean plutonium content of 16.5% is dispersed in the core in the form of CPs kernels. While loading of heavy atoms is 3640 kg, reactor average burnup amounts 9.7% h.a. Having a breeding ratio of 1.025 reactor can operates in the regime of self-provision of the secondary fuel in the closed fuel cycle. Calculational optimization of CP design has given the following performance of the CP kernel and coatings: CP outer diameter of 2000 um, kernel diameter of 1640 um, nondense pyrocarbon buffer coating of 125 um, dense pyrocarbon inner layer (IPyC) of 10 um and outer protective SiC layer of 50 um. In the paper the basic positions of the model of the thermo-mechanics of BGR-1000 coated particles are presented and calculational results revealing the effect of CP design on their behavior during irradiation are demonstrated. It is shown, that in the result of the viscous deforming the summarized volume of the kernel and buffer, limited by the elastic SiC, keeps practically invariable. In an equilibrium state volume changes of the fuel (due to its swelling) and of the pyrocarbon layers (due to radiation-induced size changes) are compensated by changing of the volume fraction of porosity in the fuel and buffer owing to their viscous deformations.

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