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Investigations in a substantiation of high-temperature nuclear energy technology with fast-neutron reactor cooled by sodium for manufacture of hydrogen and other innovative applications

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As results of neutronics and thermal physical investigations of reactor installation BN-HT type with heat rating 600 MW have shown that there is a principal possibility to provide demanded parameters of a high-temperature fast reactor for production of a considerable quantity of hydrogen, for example, on the basis of one of thermochemical cycles or a high-temperature electrolysis with high factor of thermal use of the electric power. Safety requirements will be thus observed. The relative small sizes, the coolant type, the fissionable substance and structural materials allow to create a reactor with immanent to it properties (exclusion of reactor runaway by instantaneous neutrons, passive system of decay heat removal), providing the raised nuclear and radiation safety.

By calculations BN-VT for production of electric power and hydrogen on basis of solid oxide electrolysis mass transfer hydrogen and tritium taking into account principal new method of clearing by pumping out through special membranes it is shown, that efficiency such system is ~40%, volume of maded hydrogen is 2.8104 l/s (under normal conditions). Danger from tritium in a finished stock originates after hydrogen combustion in an aerosphere. Therefore at calculation of parameters of the secondary circuit it was accepted, that maximum permissible tritium concentration in maded hydrogen should not exceed 3.26 Bk/l. Maximum concentration of permissible tritium in air is $2.44 \cdot 10^3$ Bk/l almost in 1000 times above. Clearing of sodium from tritium to the concentration providing in maded hydrogen maximum permissible concentration equal 3.26 Bk/l makes additional demands to system of clearing from hydrogen: the coefficient of permeability of system of clearing of the secondary circuit from tritium should exceed 140 kg/s.

Taking into account high temperature experiments in which high efficiency of deduction of suspended matters of products of corrosion on the filters installed in низкотемпературной to a zone is shown, it is offered to use a principle of work of a cold trap: to chill sodium to necessary temperature with simultaneous deduction of products of corrosion on mass transfer surfaces, including filters. Working out of a necessary high temperature material and its studying under radiation demands the further investigations.

Country/Int. Organization

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