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Pyrochemical recycling of the nitride SNF of fast neutron reactors in molten salts as a part of the short-circuited nuclear fuel cycle

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The scientific and technological aspects of the pyrochemical recycling of uranium-plutonium nitride nuclear fuel used in the circuited nuclear fuel cycle on the basis of nuclear power plant with fast neutron reactors were considered (in the framework of “Breakthrough” Project). It was expected that the developed pyrochemical technology allows recycling spent nuclear fuel with high energy release (1 year of cooling) and returning of uranium, plutonium and some minor actinides into a reactor.
A special attention was paid to the initial process stages, including the nitride SNF component dissolution and ionization of actinide and lanthanide nitrides using the method of “soft chlorination”by transition metal salts. The conditions to prevent uranium and plutonium nitride chloride formation were determined, and they were checked and proved by the laboratory and industrial tests.
The corrosion studies of the constructional chromium-nickel alloys in chloride electrolytes containing uranium and lanthanides salts were performed. The studies revealed that the alloys are suitable for production of electrolytic cells and other supporting apparatus operating with molten salts.
The complex investigation of physicochemical and electrochemical properties of salt compositions imitating practicable electrolytes for SNF recycling as well as actinide and lanthanide separation with the acceptable separation factor was carried out.
The conclusion was drawn on the technological feasibility of the pyrochemical technology realization in a closed nuclear fuel cycle on the basis of nuclear power plant with fast neutron reactors using mixed uranium-plutonium nitride nuclear fuel.

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