Abstracts
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Use of (Np, Am)-Faction of Minor Actinides for ^{238}Pu Production in VVER-type Reactor

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The research results of the using the Np- and Am-fractions of minor actinides for large-scale plutonium production with an isotope composition suitable for radioisotope thermoelectric generators (RTG) of spacecraft and in pacemakers are presented. An irradiation device for plutonium production is considered, which is a standard FA of the VVER-1000 reactor, in the fuel elements of which enriched uranium dioxide is replaced by a mixture of neptunium dioxide NpO_2 with americium dioxide AmO_2. It has been shown that when the central (Np, Am)-FA is surrounded by a layer of natural or radiogenic lead, it becomes possible to obtain a plutonium production rate suitable for RTG at the level of 2.7—3.3 kg/year.
Key Words: Am-, Np-fractions of minor actinides, irradiation device, VVER-1000 type reactor, natural/radiogenic lead, radioisotope thermoelectric generator.

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Uncertainty in the Prediction of the Neutron-Physical Characteristics of the RBMK Reactor Due to the Choice of the Graphite Stack Repair Scheme

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The article provides estimates of the uncertainty of predictive calculations of the RBMK-1000 neutron-physical characteristics due to the lack of information about the cutting scheme which will be used in the repair of graphite masonry. The main schemes of graphite masonry repair are considered.
Key Words: RBMK-1000, graphite masonry resource characteristics control, neutron-physical characteristics, repair scheme, uncertainty estimation.

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Modernization of the Fuel Composition of RBMK-1000 Reactors While Extending the Service Life to 50 Years

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The change in the void reactivity coefficient caused by the repair of the graphite stack of the RBMK-1000 reactors is discussed. The amount of removed graphite is estimated when extending the life of the reactors up to 50 years. A comparison was made of various options for changing the composition of the fuel. The composition of the fuel was chosen to ensure the maintenance of the void reactivity coefficient in the prescribed range while extending the service life of reactors to 50 years and maintaining the production of the ^{60}Co isotope.

Key Words: RBMK, graphite stack, service life, void reactivity coefficient.

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Estimation of the Fuel Mass in the RBMK Graphite as a Result of the Accident

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The article presents the results of model calculations of fuel accumulation in the graphite stack of the RBMK reactor as a result of an accident. The accidents that led to the ingress of fuel into the graphite stack of the reactor are described. A possible method for determining the mass of fuel remaining in the stack at the end of the reactor's life is briefly described. Some radiation characteristics of radionuclides in fuel in graphite were calculated. A calculation assessment of the activity of inert gases in the reactor space was carried out; these gases, the activity of which is regularly measured at power units, can be an indicator of the presence of fuel in the stack.

Key Words: graphite RBMK, accident, fuel.

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Code for Calculation of Temperature Fields in RBMK KLADKA-2

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The article describes the fuel element temperature calculation module, which is implemented in the KLADKA-2 code, designed to calculate stationary and non-stationary temperature fields in the structural elements of a reactor RBMK. The calculations of the heating dynamics of the drained reactor and its subsequent cooling (with the restoration of cooling of the channels of the control and protection system circuit) are compared with calculations by code STEPAN-T. It is shown that the results of calculations of fuel and graphite temperatures obtained using two codes are in satisfactory agreement.

Key Words: gas gap, graphite, temperature, thermal radiation, thermal conductivity, fuel, computer program code.

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Calculation Justification of the Parameters of a High-Temperature Gas-Cooled Reactor for Transport Power Plant

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The reactor parameters for nuclear propulsion engines were determined by calculation, ensuring minimum mass, small size, the required initial reactivity margin and nuclear safety in normal and emergency situations, taking into account modern safety and environmental requirements when launching nuclear systems into orbit and operating them in space.

Key Words: Monte-Carlo method, fast reactor, spherical fuel element.

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Investigation of Hydrodynamic Stability in VVER-SCD with Two-Pass Core with Hydraulic Profiling

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The article presents the results of a computational study of the hydrodynamic stability of the coolant flow in a two-pass version of the core of a single-circuit reactor installation VVER-SKD using the TEMPA-SC program. The possibility of periodic and aperiodic instability in the fuel assembly is analyzed, taking into account the effect of the correction on non-isothermicity. The results are compared with previously performed computational studies of stability in the single-pass version of the core and the main advantages of the two-pass version are listed. Hydraulic profiling of the lifting and lowering sections of the core for the beginning and end of the fuel campaign is proposed. The necessity of regulating the flow through each fuel assembly during the entire campaign was confirmed.
Key Words: VVER-SKD, fuel assemblies, TEMPA-SC, supercritical pressure, hydrodynamic stability.

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Thermal-Hydraulic Analysis of the MSR Burner Fueled with Transuranic Elements

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Thermal hydraulic analysis is of significant importance for the development of large power Molten Salt Reactor — Burner, known as MOSART, unit fueled by transuranic elements from VVER-1000/1200 used fuel. For 2400 MWt MSR Burner unit a loop configuration of the reactor circuit with a cyclone-type core is proposed. For the fuel salt power density above 50 W/cm^3 the selected configuration makes it possible: to eliminate of stagnant zones and uncontrolled return vortex flows for fuel salt in the core and to ensure acceptable material temperatures in the reactor circuit.
Key Words: core, molten salt reactor, MOSART, primary circuit, thermal-hydraulics, fuel salt, transuranic elements, lithium and beryllium fluorides, cyclonic flow.

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Development of Irradiation Ampoule Devices to Study Fuel Rod Cladding Properties in the Coolant with Supercratical Parameters

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An important step in the development of innovative water-cooled reactors with supercritical coolant parameters (SCWR) is to study experimental fuel rods operating under conditions close to full-scale ones. Such tests are planned, in particular, at the IR-8 reactor of the NRC “Kurchatov Institute”. The article focuses on the development of ampoule devices to examine fuel rod claddings in a coolant with supercritical parameters. The characteristics of reactor tests performed in conditions of natural convection are reviewed. The schemes of ampoules for irradiation of experimental fuel rods and fuel rod simulators as well as possible ways of equipping them with sensors to obtain real-time information on the test parameters are shown.
Key Words: IR-8 reactor, ampoule device, SCWR, experimental fuel rod, equipping of fuel rod cladding.

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Experimental Study of the Corrosion Resistance of Nickel-Molybdenum Alloys in the Melt of Lithium and Beryllium Fluoride Salts

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The results of tests of corrosion and mechanical resistance of the alloy KHN80MTY and its modifications under dynamic non-isothermal conditions of circulation of a coolant of molar composition 0.66LiF—0,34BeF$_2$ in the range of operating parameters of the intermediate circuit of the MSR are presented. Three of the most promising compositions of candidate alloys for MSR were selected. It was shown that, in terms of the rate of uniform corrosion and mechanical properties, the alloys are able to ensure reliable operation of the structure for up to 30 years with a maximum temperature of up to 690 °C, if the melt redox-potential is maintained in the range of values of $E_{\mathrm{PBe}} = -(0.59—0.79)$ V.

Key Words: corrosion, Ni—Mo alloys, molten salt reactor, molten salt lithium beryllium fluorides, scanning electron microscopy.

UDC 533.9

On the Parameters of a Centrifuge at Which an Isotopically Selective Atomic-Molecular Exchange in Nitrogen Occurs in its Rotor

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A method is proposed for enrichment of the nitrogen atomic component, which is formed as a result of the dissociation of molecules when a nitrogen stream passes through an electric discharge zone and enters the centrifuge rotor as a feed flow, by an isotope ^{15}N. The parameters of the centrifuge and the values of the feed flows are estimated, at which the mean vibrational energy of nitrogen molecules in the rotor is established in the range $\varepsilon \cong (3 — 4)10^{-2}$ eV at the translational gas temperature T = 300 K and at the concentration of molecules N$_2$ 10^{17} cm^{-3}, and isotopic enrichment of N atoms can be achieved more than 30 times higher than natural as a result of atomic-molecular exchange.

Key Words: atomic-molecular exchange, isotope, nitrogen, centrifuge.