

Abstracts

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Comprehensive Experiments on Subcritical Assemblies of Cascade Reactor Systems

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Particular attention is attracted by cascade reactors because of the presented by them possibilities to improve with their aid parameters of pulsed reactors and realizability of electronuclear facilities. The results of three series of experiments on uranium-neptunium cascade assemblies performed in INRP VNIIEF within the years of 2003–2004 are presented in the paper. The experiments confirmed theoretical conclusions on positive properties of cascade blankets and effectiveness of using neptunium-237 as a means of achieving one-sided connection between the sections.

Key words: cascade reactor, cascade blanket, pulsed reactor, neptunium-237, electronuclear facility, reactor experiment.

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Metal Core Reactor Planned Destruction: Simulating of Catastrophic Accidents and New Experimental Possibilities

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At VNIIEF the reactor with destructible core RIR with pulse energy output $\sim 1,5 \times 10^{19}$ fissions, half-width $\sim 2,5 \mu\text{s}$ was designed and tested. In the course of investigation experiment-calculated method of RIR laboratory calibration was generated and worked out. This method secured energy output high accuracy prediction in real experiment with excess reactivity $< 3\beta_{\text{eff}}$ above prompt criticality. Transportable explosion-proof chamber was designed too. This chamber safely localizes blast products of RIR-type core or high explosive charges with equivalent mass up to 100 kg TNT.

Key words: pulse reactor, destructible core, fission pulse, reactor calibration, transportable safety chamber.

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The History of Criticality Experiments Progressa at RFNC-VNIIEF

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This report is a brief presentation of one of the important research topics of RFNC-VNIIEF. Historically, we create facilities for experimental studies on the critical assemblies of metallic fissionable materials (FM). Summarized the work carried out in the RFNC-VNIIEF in order to create new RNF, information for testing integrated nuclear data; nuclear safety in the production, storage and transportation of metallic FM.

Key words: criticality experiment, critical assembly, fissionable material, nuclear safety, critical stand, history of criticality experiments.

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History of Formation and Practical Realization of Coupled Reactor Concept

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The history of formation and practical realization of a concept of coupled reactor facilities that was embodied in the sphere of aperiodic pulsed reactors is traced back. It is demonstrated that the application of the concept of coupled reactor facilities extends essentially the potentialities of the executed on reactor experiments.

Key words: concept of coupled reactors, realization of coupled reactors, pulsed reactors, reactor experiments.

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Evolution History Of Cascade Reactors Concept

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The history of cascade reactor concept evolution and the development on its base of pulsed reactor devices with ultimately short pulse duration and blankets of electronuclear facilities with multiply decreased requirements to proton accelerator power is traced back. It is demonstrated that considerable contribution to the development of cascade reactor concept is made by the specialists of INRP VNIIEF.

Key words: cascade reactor, pulsed reactor devise, pulse duration, electronuclear facility, blanket, proton accelwrator.

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Natural Transmutation of Actinides by the Fission Reaction in the Closed Thorium-Uranium-Plutonium Fuel Cycle

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It is shown that in the closed thorium-uranium-plutonium fuel cycle when processing one ton of irradiated fuel after each of four-year campaigns radioactive wastes will contain ~54 kg of fission products, ~0.8 kg thorium, ~0.10 kg if uranium isotopes, ~0.005 kg of plutonium isotopes, ~0.002 kg of neptunium and <trace> amounts of isotopes of americium and curium, that qualitatively simplifies the treatment of high-level wastes of nuclear power engineering.

Key words: PWR- or VVER-type reactor, D₂O coolant and its dilution with H₂O, thorium-uranium-plutonium fuel cycle, balanced isotopic composition, transmutation of actinides by fission reaction.

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Pulsed Reactor Parameters for Pumping a Large-Size NPL

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There is advanced and substantiated by calculations the design of a fast pulsed reactor with a large axial cavity that can contain a multi-channel laser module to generate high-power pulses of optical radiation. There are given the calculation results of reactor parameters as well as those of displacements and tensions in its fuel rods. Preliminary conclusions concerning the procedure of fission pulses generation in the suggested reactor are formulated.

Key words: pulsed reactor, cavity into core, reactor parameters, multi-channel laser module, pulses of optical radiation.

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Experimental Investigations of Fuel Elements Behavior under Accident Conditions at the BGR Reactor

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General information on RIA type conditions modeling tests of fuel elements in pulse reactor BGR is presented. Some issues on tests setup and methodology development related to modern period of activities are described.

Key words: BGR reactor, pulsed irradiation of fuel elements, simulation of reactivity accident, irradiating devices.

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The Calculation Methodology by the Example of $^{178m2}\text{Hf}$ Hypothetical Isomeric γ -Reactors

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By example of nuclear isomer $^{178m2}\text{Hf}$ there was developed the methodology of describing kinetic phenomena in isomer gamma-reactors. The consideration of processes in isomer medium is based on a supposition that as a result of using resonance mechanism NEET it is possible to put isomer to trigger state and thereby create conditions for chain reaction of γ -decays similar to the chain reaction of fissions in neutron nuclear reactors.

Key words: nuclear isomer, hafnium, γ -reactor, methodology of calculation, trigger state, resonance mechanism, reactors kinetic.

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High-Sensitivity Fast Neutron Detector KNK-2-8M

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There is given a brief design description of KNK-2-8M detector of fast neutrons. There are presented the results of detector studies in the mode of counting pulses of ^{238}U nuclei fission in a radiator of a neutron-sensitive section and in the current mode when sectional currents of functional sections are separated. There are considered the determination possibilities of the effective number of ^{238}U nuclei. The detector diagnostic capabilities in the count mode are demonstrated by the example of reference data analysis performed on the base of the characteristics of neutron fields in the working hall of BR-1 nuclear reactor. The detector diagnostic capabilities in the current mode are illustrated by the results of ^{238}U fission rate measurements. These data were obtained during BR-K1 nuclear reactor power startups implemented in the mode of generating fission pulses on delayed neutrons at the detector arrangement inside the zone cavity of the nuclear reactor under a wide variation of nuclear radiation fields.

Keywords: gas-filled detector of ^{238}U fission, nuclear reactor radiation field, count-current operating mode of detector, count adjustment, hardware-software registration system.

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Production of Fuel Elements Using a Method of Capillary Impregnation of Graphite Blocks with Organic and Water-Organic Solutions of Uranyl β -Diketonate

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A method of producing fuel elements through capillary impregnation of graphite blocks with organic and water-organic solutions of uranyl beta-diketonate is advanced. Basic investigation results are presented. There is produced a set of fuel elements with the uranium content of 0.45÷0.55 mass fraction (%). The distribution of fissile element inside graphite blocks is estimated.

Key words: fuel element, graphite block, uranyl β -diketonate, capillary impregnation, annealing, organic solvents.

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Design and Calculation Peculiarities of a Pulsed Nuclear Reactor Pneumatic Actuator

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There is described the design of pneumatic actuator aimed at rapid transfer of the pulsed nuclear reactor work member. There was performed the analysis of dynamic characteristics of thermodynamic and mechanical subsystems. The interaction of these subsystems at the time of the actuator transfer is demonstrated. The calculated model of a one-dimensional unsteady flow of viscous medium in a cylindrical tube as well as the generalized calculated model of the pneumatic actuator is demonstrated. The calculation of the mechanism dynamic characteristics is performed. It is shown that the generalized calculated model can be used to determine optimal design parameters and pneumatic actuator characteristics at a design stage.

Key words: pulsed nuclear reactor, pneumatic actuator, pipeline, laminar and turbulent flow, unsteady flow.