

Abstracts

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Spectral Indices Measurement in Critical Cylindrical Uranium System with Lithium Hydride End Reflector

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The work considers precision experiments results, which show neutron passage through the layers of lithium hydride-7. Activation integrals of neutron-activation detectors, positioned in various points of composite lithium hydride-7 reflector, were determined. The reflector was mounted at the end of uranium breeder system. Spectral indices were calculated on the basis of the obtained data.

Key words: benchmark-experiments, uranium breeder systems, neutron-activation method, activation integral, spectral indices.

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Assessment of Reactivity Temperature Effect in Small-Size Plutonium Systems

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The work considers the impact of temperature change in plutonium breeder systems (BS) on their reactivity and critical parameters during integral critical experiments conducted in VNIITF. BS temperature reactivity factors (TRF) $\frac{\partial \rho}{\partial T}$ were assessed according to the dependency of the multiplier factor Q on the BS temperature and according to the change in drop constant α . Experimental and estimated (with Monte Carlo method) TRF values were compared. BS extreme clearance under various temperatures was measured (operating with natural heatsink and coupled with air-cooled system).

Key words: benchmark-experiments, plutonium breeder systems, correlation experiments, reactivity temperature factor, asymptotic drop constant.

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Advantages of Thorium-Uranium-Plutonium Fuel Cycle in the Future Nuclear Power Industry over the Current Uranium-Plutonium Fuel Cycle

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Fissile materials of the first generation – uranium and plutonium – exhausted their potential in the open uranium-plutonium fuel cycle and don't allow resolving the problems of the modern nuclear power industry. materials by ^{232}Th – ^{233}U materials, which are more appropriate for nuclear industry, i.e. it is In the changeover from the open fuel cycle to the closed one, it is suggested to replace ^{238}U – ^{239}Pu fissile suggested to use materials of the second generation, rather than reactors of the other type (fast reactors instead of thermal reactors). This would allow extending the fuel lifetime by ~ 2 orders of magnitude, simplifying the radioactive waste management, reducing the nuclear risks of the VVER-type reactors, and creating a technological barrier against the propagation of fissile materials and nuclear technologies.

Key-words: VVER-type reactor; ^{232}Th and ^{233}U isotopes of the second generation; heavy water as a

coolant and its dilution with light water; self-production of active isotopes in fuel; closed thorium-uranium-plutonium fuel cycle; natural transmutation of actinides by fission reaction; simplifying the radioactive waste management.

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Absolutization of Supercriticality Levels Measured with the Aid of Technique of Source Neutrons Multiplication and Method of Squares

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There are considered different versions of the technique of source neutrons multiplication taking advantage of reactivity of «reference» level that was developed in the foreign institutes in order to determine reactivity of deeply subcritical reactors. The results of using in the above-specified technique and in the method of squares of the experiment calculated simulation of experiment making it possible to get sufficiently

precise data with no «reference» level involved are discussed. The expedience of using the method of the experiment calculated simulation in the versions of the source neutrons multiplication technique applied in some institutes of Russia in the procedure of critical mass experiments is conditioned.

Key words: reactivity, reactor, critical assembly, multiplying system, technique of source neutrons multiplication, method of squares, method of experiment calculated simulation, critical mass measurements.

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Main Results of Investigations of Nuclear-Pumped Lasers in VNIIEF

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In the report the short review of researches of nuclear-pumped lasers conducted in VNIIEF is presented.

Key words: laser, nuclear pumping, research nuclear reactor.

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Energy Deposition in Nuclear-Pumped Lasers

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The review of results of experimental investigations, devoted to determination of energy deposition in nuclear-pumped lasers is presented. There are three methods presented: 1) pressure jump method; 2) interferometric method; 3) string calorimeter method. The comparative analysis of experimental and calculation results devoted to determination of energy deposition in laser cells by fission fragments is carried out.

Key words: interferometer, string calorimeter, laser, nuclear pumping.

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Optical Inhomogeneities in Nuclear-Pumped Lasers

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This report contains major steps of calculation studies of optical inhomogeneities in nuclear pumped lasers.

Key words: laser, nuclear pump, optical inhomogeneities.

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Model Description of Pulsed Reactors Used at Calculation Accompaniment of Irradiation Experiments

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The computational models of reactor facilities in the Institute of Nuclear and Radiation Physics (RFNCVNIIEF) verified by experimental data are presented in the paper. The usage of these models allowed getting a priori information on neutron spectra essential for neutron field diagnostics with the aid of activation methods. The possibility of using computational models for irradiation experiments planning is shown.

Key words: nuclear-physics facility, Monte-Carlo method, activation integral, energy spectrum of neutrons, gamma-radiation dose, experiment planning.

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A Method of Calculating a Number of Fissions in VIR-2M Reactor Basing on the Yield of Fission Products

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There is described a method of calculating fission number of uranium in VIR-2M solution nuclear reactor during a long period based on the results of spectroscopic analysis of fuel solution samples. The results of calculations performed using this method within the period of 17 years are presented. It is demonstrated that in the core of nuclear reactor VIR-2M for one MJ of released energy there is $3.13 \cdot 10^{16}$ fissions of uranium.

Key words: pulsed reactor, water solution of uranyl sulphate, number of fissions, fission products, nuclear decay.

UDC 621.031.585

Study Results or Intensity of Thin Carbon Films Sputtering by Uranium Fission Fragments

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There are presented in the paper the results of investigating sputtering by uranium fission fragments of thin carbon films produced by a method of thermal vacuum deposition. In accordance with the investigations carried out the intensity of carbon films sputtering does not exceed ~ 50 atom/fission fragments what indicates the possibility of their use as protective coating for uranium layers.

Key words: protective coating, carbon films, sputtering by uranium fission fragments, atomic-force microscopy.

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Pulsed Operation of Reactor VIR-2M. Enhancement of Performance Capabilities

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There are investigated new modes of VIR-2M reactor operation that made it possible to extend essentially the reactor irradiation capabilities. For the pulsed mode irradiation there are developed new algorithms of reactor control allowing realization of gamma-neutron quasi-pulses of the specific shape with the characteristic exposure time 1 – 20 s. The possibility of generating the so-called «additional-power pulses» making it possible to fulfill irradiation in the range of energy release values per pulse from 1 to 25 MJ (the range of pulse «half-width» values is from 5 to 100 ms) is studied.

Key words: pulsed nuclear reactor, gamma-neutron pulse, quasi-pulse, pulsed rod, fuel solution, reactivity.

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Reconstruction Of Control And Protection System For Pulsed Reactor BARS-5M

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The description of technical solutions used for modernization of the reactor control and protection system is given. The report shows the block diagram, description of its design and operating principle.

Key words: modernization of the reactor control and protection system, pulsed reactor, block diagram.

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Experiment Versus Computation in Determining the Number of Reactions in Uranium and Nickel Detectors on BARS-5M+RUN-2 Complex

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The number of reactions in U-, and Ni-neutron detectors fixed at different points of reactor cores was measured on the TIRAN complex. In parallel, the number of reactions in these detectors was calculated by the Monte Carlo method using the PRISMA-D code with the ENDF-BVI neutron constants library. Comparison of obtained results showed close fit between experiment and computation. Our study helped to update values of coupling factors between energy release in the complex's reactor core and readings of activation-neutron Ni-monitors.

Key words: reactor, energy release, total fissions, activation neutron detectors, ENDF-BVI neutron constants library, PRISMA-D code, Monte Carlo method.

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Ensuring Uniformity of Neutron Measurements on Nuclear-Physical Facilities at RFNC-VNIITF

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Basic principles and instruments for metrological assurance of neutron measurements performed on nuclear-physical facilities at RFNC-VNIITF are considered. A local measurement chain for instruments to measure the neutron flux fluence and density on RFNC-VNIITF nuclear-physical facilities is also provided. Consideration is given to certain elements of the measurement chain, i.e. the reference and modeling neutron

field in the TIRAN reactor, neutron sources in the JAGUAR, IGRIK-2, and EBR-L reactors, the modeling field in the NG-12I neutron generator, and the complex of instruments to measure the number of reactions in activation-neutron detectors and fission-neutron detectors.

Key words: nuclear-physical facilities, metrological assurance, neutron fluence, activation-neutron detectors, measurement error.

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Investigation of Fuel and Cladding of the Model Fuel Elements for Fast Reactors under Neutron Irradiation by the BARS-6 Pulsed Research Reactor

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This paper focuses on the calculations and experimental studies of thermo-mechanical processes in a fast reactor fuel elements needed to substantiate their safety. The experiments were carried out on the BARS-6 pulsed research reactor using the model fuel rods that imitated the fast reactor fuel elements. The experimental data showed that as a result of exposure to neutron pulse of the BARS-6 reactor, the maximum average temperature of uranium fuel in periphery of layer reaches 2700 K and is close to the melting temperature of uranium dioxide.

Key words: fast pulsed reactor, reactor BARS-6, model fuel element, model fuel element fuel and cladding, neutron radiation, thermomechanical process, uranium dioxide.

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Research of the External Environment Influence on Pulsed Research Reactor BARS-6 Parameters

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The paper presents the calculation results of the influence of construction materials of experimental devices located near the reactor BARS-6 on the neutrons average lifetime. The calculations were performed for different distances between the reactor active cores with various thicknesses of polyethylene moderator in the experimental device. The influence of the model of the human body on reactivity during routine work on the reactor was calculated.

Key words: pulsed reactor BARS-6, neutrons lifetime in the reactor, effect of surrounding objects on the lifetime of neutrons, calculation of the effect dependence on the type and geometry of surrounding objects.

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Pneumatic Drive for Actuating Mechanism of Research Pulsed Reactor BR-K1 Control System

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The pneumatic systems aimed at controlling the pulsed nuclear reactor BR-K1 system tool moving are presented. High-speed pneumatic systems of different design are analyzed. The most promising design version meeting the required parameters is selected. The generalized model describing the operation mode of the preferred design system is presented. The calculation of this model is carried out. The results of calculations are in good agreement with the test results.

Key words: pulsed reactor, control and protection system, pneumatic system.

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**Determination of Thermalphysic and Dynamic Parameters of Gas Medium
in Fuel Blocks of Aperiodic Pulse Reactor BR-K1**

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There is presented a thermodynamic system of excessive pressure release in a block of BR-K1 reactor core after a fission pulse on prompt neutrons is generated. Physical phenomena affecting the changes of pressure in the core block are shown. The analytical model of such effects account is presented. There are made computations, determined thermodynamic parameters in the block after the fission pulse generation. It is demonstrated that thermodynamic processes in the reactor core block are transient – they are tens of milliseconds long. The data presented can be useful for specialists dealing with APR design and operation.

Key words: critical stand, section of active zone, critical parameters, reactivity, temperature reactivity coefficient.

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**Fading-Correction of Readings of Glass Gamma-Radiation Dosimeters SO PD (DTS)-0.05/10
within the Interval of Post-Irradiation Measurements from 1 to 100 Days**

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There are presented the results of experimental study of post-irradiation variation (fading) of SO PD (DTS) dosimeter readings within the interval from 1 to 100 days after radiation loading by reactor (BR-K1) and bremsstrahlung (LU-10-20) gamma-quanta within the interval of absorbed doses from 50 Gy (*water*) to 10 kGy (*water*). There is advanced a formalism for fading-correction of dosimeter dose readings based on the application of degree and logarithmic forms of functional dependence for the ratios of light-transmission coefficient conditioned by radiation loading and its values obtained at arbitrary time points after irradiation is completed.

Key words: solid-state glass dosimeter SO PD (DTS)-0.05/10, post-irradiation variation of dosimeter readings (fading), digital spectrophotometer, light-transmission coefficient, functional of light-transmission coefficient variation, functional of light-transmission coefficient variation correction.