

## Abstracts

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### **Nuclear and Electrophysical Facilities of RFNC-VNIIEF: the Present and the Future**

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It's presented a review of RFNC-VNIIEF activities aimed at operating facilities reconstruction and design of new nuclear and electrophysical installations as powerful ionizing radiation sources.

**Key words:** criticality machine, nuclear pulse reactor, charged-particle accelerator, ionizing radiation.

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### **The First Stage Results of the BR-K1M Research Nuclear Reactor Physical Commissioning**

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In 2020 there were carried out the first stage activities on the research nuclear plant BR-K1M physical commissioning. The paper presents the results of critical mass and physical researches on research nuclear plant RNP BR-K1M. There are described measuring methods, configuration and schemes of experimental equipment applied to determine characteristics of RNP BR-K1M. The comparative analysis in fission density distribution between the obtained RNP BR-K1M characteristics and those of the RNP BR-K1 is presented.

**Key words:** nuclear research plant, BR-K1, BR-K1M, method of squares (Shestrend method), the method of inverse solution of kinetic equation (ORUK method), reference reactivities, Babal's method, autocorrelation method, relative distribution of fission density, counting channel efficiency, current channel efficiency, lifetime of prompt neutrons, activation method, temperature growth.

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### **Investigation of Iodine Effect on Resource Characteristics of a Palladium Catalyst Intended for the System of Radiolytic Gas Catalytic Recombination**

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The effect of iodine on the resource characteristics of a palladium catalyst for the catalytic recombination of radiolytic gas system (RGS) of the VIR-3 research nuclear reactor (RNR) with a solution core was studied. The maximum content of iodine in the fuel solution (FS) of the reactor, formed over a 30-year operating period with a total energy release of 900 GJ, is calculated. Experiments on the catalytic oxidation of a hydrogen-oxygen mixture supplied through acidified iodine fuel solutions of ferrous sulfate (MFS) were carried out on the RGS model. It was found that the gas bubbling of the MFS leads to the

evaporation of iodine into the catalytic unit of the RGS model with subsequent poisoning of the catalyst. The estimated service life of the catalyst in the RGS RNR VIR-3, only due to iodine «poisoning», will be no more than 7.5 years. A method is proposed for increasing the service life of a catalyst by neutralizing iodine in a fuel solution and a vapor-gas mixture of solution RNR equipped with an RGS.

**Key words:** Core, research nuclear reactor, fuel solution, radiolysis, radiolytic hydrogen, catalytic hydrogen recombination system, iodine isotopes, granular palladium catalyst.

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### **Advanced Solution-Type Pulsed Reactor: Neutron-Physics Characteristics and Irradiation Parameters**

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In the article there are presented the proposals concerning the aspect of the advanced solution-type pulsed reactor planned to replace the VIR-2M reactor operating today in RFNC-VNIIEF. It is demonstrated that the calculated irradiation parameters of the advanced reactor are ~2 times higher than the radiation parameters of the operating VIR-2M reactor.

**Key words:** aperiodic pulsed reactor, neutron-physics calculation, core, reactivity regulating elements, catalytic recombination system.

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### **Features of Radiolytic Boiling of a Solution Homogeneous Reactor in Static Mode of Operation**

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The mechanism of radiolytic boiling in solution homogeneous reactors when operating in static mode is considered. The spectrum of the size distribution of the merging bubbles, originally born on the tracks of fission fragments, was found. Equations are derived that reflect the growth of bubbles due to diffusion of dissolved gas. In the approximation of bubble sizes averaged over the obtained spectrum, we calculated both the bubble growth rate and the dynamics of concentration of dissolved radiolytic gas. It was shown that for an adequate description of the gas exit from the solution through the free surface of the core, it is necessary to take into account the merging of bubbles upon floating.

**Key words:** radiolytic boiling, solution reactor, static mode.

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**Coordination Analysis for Experimental and Calculated Values of the Effective Neutron Multiplication Factor  $K_{ef}$  for Critical Assemblies with a Reflector of Beryllium and Polyethylene**

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The coordination analysis of experimental and calculated critical parameters is conducted for the studied before critical assemblies with the cores of uranium and plutonium and reflectors of beryllium and polyethylene. The calculations were performed using the C-007 program with the following libraries of nuclear-physics constants: BAC, ENDF/B and Jendl.

**Key words:** critical assembly, uranium, plutonium, core, effective neutron multiplication factor, library of nuclear-physics constants.

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**Investigation of Stable Fission Product Chains in Reactors with a Weak Neutron Source**

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There is performed the analysis of the published experimental works in studying stable fission-product chains evolution in reactors with weak neutron source. It is demonstrated that the difference between the results obtained on GODIVA-II and other experimental data is observed.

**Key words:** reactor, fission-product chain, effective neutron multiplication factor, core, neutron.

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**On Terminology Ambiguity of Some Units of Measurement in the Fields of Reactor Plants**

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It is proposed to introduce to the sphere of reactor plants special terms, verbal and functional definitions of a source neutron flux, a field neutron flux, neutron field flux density and neutron field fluence that make it possible to exclude terminology ambiguity available in currently in force guidelines developed in Russian RMG 78-2005, MI 2630-2000 GSI and substantiate physical correspondence between the concepts of neutron flux density and neutron fluence rate available in guidelines ICRU REPORT No.85 developed in English. The application forms of the functioning national standards of flux, flux density and neutron fluence would not be touched on.

**Key words:** source neutron flux, field neutron flux, flux density of neutron field, neutron field fluence, verbal and functional definition of concepts.

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**Calculation-and-Experimental Method for Determining Efficient Fraction of Delayed Neutrons in Fast Multiplying Systems**

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Presented is a calculation-and-experimental method for determining delayed neutrons efficient fraction in fast multiplying systems, being in delayed criticality state. For such systems there is found a physical quantity, which can be specified in experiments and calculations and which thus can be used for testing and correction of neutron constants. The method is applied to analysis of experimental data for systems, consisting of metallic high-enriched uranium and plutonium.

**Key words:** calculation-and-experimental  $\beta_{\text{eff}}$  determination method; fast multiplying systems; delayed criticality; testing and correcting of neutron constants.

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**On the Possibility of Regulating the Time Interval Between Pulse Peaks of Reactor BR-1M and Accelerator LIU-30 in the Mode of Their Joint Operation**

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The peculiarities of fission pulse formation in BR-1M and accelerator LIU-30 in the mode of the facilities joint operation are analyzed. There are considered the versions of design realization and spatial displacement of a specialized high-speed reactivity regulator with the rated possibility of a considerable effect on the value of the interval between the peaks of LIU-30 and BR-1M pulses at the initiation of the reactor fission pulse with the fixed parameters by the accelerator radiation pulse.

**Key words:** reactor fission pulse, relation between accelerator and reactor pulses, specialized high-speed reactivity regulator, variability of the interval between pulse peaks of the facilities.

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**Simulation of Recoil Proton Spectrums in a Detector of Proton Telescope Type at D-T Neutrons Registration**

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In the paper there are presented the description and the principle of operation of the proton telescope-type detector applied in FSUE «RFNC-VNIIEF» to register DT neutrons. The prime objective was to simulate spectra of recoil protons in the detector including accounting of kinematics of elastic scattering  $H(n, n)$ , losses of proton energy in hydrogenous radiator and scintillator, light yield nonlinearity of inorganic scintillators. As a result of calculations the spectra of recoil protons for several energies of neutrons were obtained. The results of calculated spectra comparison with the results of experiments on DT neutrons are presented.

**Key words:** recoil proton monitor, elastic neutron scattering, charged particles, neutron generator, amplitude distribution function.

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**Calculation Estimate of Space Distribution for Gamma-Radiation Dose  
in an Experimental Hall of Neutron Generator NG-11I**

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There were undertaken calculation researches of the fields of DT-neutrons and gamma-quanta formed during the NG-11I neutron generator operation. There was demonstrated the influence of the neutron generator structural elements and secondary equipment available in the experimental hall on the formation of neutron spectrum and gamma-radiation dose. The space distribution calculation of gamma radiation equivalent dose rate in the experimental hall of generator NG-11I is presented.

**Key words:** neutron generator, neutron spectrum, angular distribution of neutrons, equivalent dose rate.

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