

Abstracts

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High-Flux Pulsed Neutron Source on the Base of Cascade Booster

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A physical model of high-flux neutron source based on subcritical ($k_{\text{eff}}=0,96$) two-stage booster, managed by proton accelerator with energy of 600 MeV and 0,3 MW beam power is offered. It is shown that the thermal neutron flux will be comparable to the flux density in the European Spallation Source (ESS), power proton beam which is 5 MW. Due to a short pulse the experiments on the proposed source on neutron diffraction will be almost an order of magnitude more efficient than in ESS.

Key Words: high-flux pulsed neutron source, subcritical fission system, cascade booster, neutron beams.

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Results of the Control Rods Reactivity Measurements in the Critical Assembly by the Reactimeter RKI-1

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The values of the control rods reactivity in the critical assembly by the reactimeter RKI-1 were measured. Software of RKI-1 allows to process primary experimental data by “the method of corrections” and “integral method”.

Key Words: reactivity, control rods, critical assembly, inverse kinetic technique.

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Study of the Efficiency of the Parallel Algorithm for Solving the Eigenvalue Problem Implemented in the LUCKY-A Computer Code

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The paper is devoted for study of the efficiency of the parallel algorithm for solving the eigenvalue problem, implemented in the LUCKY-A computer code. The algorithm was created especially for supercomputers with MPI technology of data exchanging between parallel processes. A test problem (model of fast breeder) was calculated by LUCKY-A, TORT and MMKKENO computer codes. The dependence of the parallel algorithm efficiency on space domain decomposition was studied.

Key Words: algorithm, transport equation, $P_m S_n$ approximation, iteration process, computer code, supercomputer, parallel process efficiency, solution, space domain, base solution.

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Calculation C5G7 Benchmark by LUCKY-A Supercomputer Code

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The results of calculation by LUCKY-A computer code for C5G7 benchmark are presented (K_{ef} , the fission power distribution). The parallel algorithm for solving the critical and distributed source tasks by LUCKY-A code was created especially for supercomputers with MPI technology of data exchanging between parallel calculating processes.

Key Words: parallel algorithm, $P_m S_n$ approximation, results, benchmark, program, supercomputer, space domain.

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Calculation of the Reactivity Effects with Feedbacks for the Fast Reactor Core in the Software Package GEFEST.

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The methodology for the improvement of accuracy of the reactivity effects calculations with temperature and geometrical parameters feedbacks in the fast neutron reactors was developed in the software package GEFEST. The algorithm of the axial fuel layers displacement accounting was created to take into consideration feedbacks. Results of comparison with experimental data of the power and temperature coefficients reactivity for BN-600 and BN-800 reactors are presented. The feedback contribution at the reactivity effect is estimated.

Key Words: reactivity effects with feedback, BN-600, BN-800, the coefficient of reactivity, thermomechanics.

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Influence of Heterogeneity of Spherical Fuel Element Pebble Bed Structure on Physical and Thermal-Physical Characteristics of HTGR with a Pebble Bed Core

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The paper presents the results of analysis of the influence of the fuel movement velocity field and distribution of fuel element pebble bed porosity on the spatial distributions of energy release and fuel temperature in pebble bed cores of high-temperature gas-cooled reactors (HTGR) with continuous fuel element reloading. Normal operation conditions are considered, as well as an emergency situation with compaction of the pebble bed of spherical fuel elements as a result of a seismic action. Coupled neutron-physical and thermal-hydraulic calculations were performed taking into account experimental data on the distribution of pebble bed porosity obtained in Russia in model experiments. The results of studies show the need to take into account the detailed distribution of porosity in reactor physics calculations, as well as in experiments on critical assemblies simulating HTGR cores with spherical fuel elements.

Key Words: HTGR, pebble bed of spherical fuel elements, fuel movement velocity field, pebble bed porosity distribution, coupled neutron-physical and thermal-hydraulic calculations.

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Calculated Data Analysis of the VVER-1000 Fuel Rod Thermal-Mechanical Properties after Irradiation Testing in a Research Reactor under LOCA Conditions

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The paper covers data related to a thermal strength analysis of a single refabricated high-burnup fuel rod and test rig design components. The results of the MIR-LOCA/72 experiment are presented. Thermal-physical and strength calculated data are compared with the obtained experimental data.

Key Words: experiment, loss of coolant accident (LOCA), MIR reactor, thermal strength calculation, refabricated fuel rod, cladding, strain, stress intensity, test rig.

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Re-Embrittlement of VVER-440 Pressure Vessel Materials after Annealing

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The analysis of mechanical tests results and published microstructure studies of VVER-440 RPV (reactor pressure vessel) base and weld materials after post-annealing re-irradiation were done. Dependence of reembrittlement rate of the VVER-440 RPV weld material after post-annealing re-irradiation on the neutron flux density during primary irradiation was identified. The models for assessment of radiation-induced embrittlement after post-annealing re-irradiation of VVER-440 RPV weld material and base metal taking into account the state of material after the primary irradiation and annealing was proposed.

Key Words: re-embrittlement, annealing, prediction, reactor pressure vessel, flux.

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On the Stochastic Theory of Neutron Transport in a Nuclear Reactor. Stochastic Critical Equations and Solutions

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We derive the linear criticality stochastic equations corresponding to main eigenvalue and eigenfunction of homogeneous criticality Boltzman equation of neutron transport. Then the analytical solutions are obtained for stochastic equations with a special critical neutron source, neutron flux variety and diagram for asymptotic neutron number probability function.

Key Words: criticality equations, stochastic, nuclear reactor, reactivity, starting mode.