

Abstracts

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***The Computer Code System DAREUS for Modeling the Dynamics
of Nuclear Solution Reactors Using Monte Carlo Method***

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The computer code system DAREUS intended for modeling the dynamics of experimental nuclear solution reactors using Monte Carlo method is described. KIR Monte Carlo code is used for the calculations of the point kinetics parameters. Some results of test calculations are given.

Key Words: Calculation, Dynamics, Kinetics, Solution Reactor, Monte Carlo Method, Super Computer.

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The Solution Reactor “Argus” Nuclear Safety Validation Using Code DAREUS

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The solution reactor “Argus” is described and main principles of experimental validation of its nuclear safety are given. The computational confirmation of this validity is given using DAREUS computer system. It worked out for modelling the dynamic processes in the cores of experimental solution reactors.

Key Words: Calculation, Dynamics, Kinetics, Solution Reactor, Safety Validity, Monte Carlo Method.

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***Analysis of the Improved Quasistatic Approximation Algorithm
of the Nonstationary Neutron Transport Equation Solution***

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This paper is devoted for the analysis of neutron transport equation solution with an improved quasi-static algorithm on the example of the diffusion approximation. The algorithms of combined schemes based on an improved quasi-static approximation were offered to minimize the inaccuracy of solution results. Analysis of inaccuracies of kinetics calculation was conducted by test tasks.

Key Words: Neutron Transport Equation, an Improved Quasi-Static Approximation, Reactivity, Adjoin Function, Kinetics, Diffusion Approximation, Reactivity Inaccuracy, Perturbation Theory.

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***On Possible Accuracy Improvements in Neutronics Calculations –
Comparison of the SP₃ and Diffusion Approximations***

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One dimensional analytical solutions for the one and two energy group diffusion, SP₃ and P₃ equations are used to investigate the effect in nodal calculations. The results are compared with results of calculations of the transport codes. SP₃ results show improvements in comparison with diffusion solutions for the nodal test cases using fuel assembly sized nodes. Comparing with a multi-group transport solution shows that the diffusion solution sometimes demonstrates better results due to error cancellation. The analysis of the pin-by-pin configurations show a clear improvement given by the application of the SP₃ method. However, the deviations of the results for the pin-by-pin calculations are still unacceptably high.

Key Words: SP₃ Approximation, Diffusion Approximation, Nodal Methods, Fuel Assembly, Fuel Pin.

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***The LUCKY-A Computer Code. Parallel Calculations for the Neutron and Gamma
Radiation Transport Problems***

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The LUCKY-A computer code is discussed. The parallel algorithms for the solution of transport equation and time-dependent transport equation by space decomposition method are presented. The algorithms were created especially for supercomputers with MPI technology to exchange data between parallel processes.

Key Words: Algorithm, Transport Equation, P_mS_n Approximation, Program, Module, Supercomputer, Parallel Process Efficiency, Solution, Space Domain, MPI Technology, Base Solutions.

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The View After 30 Years on the Origin and Development of the Chernobyl Accident

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The value of the positive scram effect which was the trigger of the accident according with the authors opinion is discussed. The results of the calculation by new version of the STEPAN code which uses surface harmonics method for neutron field description is discussed. The value of the neutron burst is estimated based on the high graphite temperature (more than 1000 °C) observed after the reactor destruction. The influence of the neutron burst on the radiation characteristics and decay heat of the fuel is considered.

Key Words: Reactivity, Neutron Power, Chernobyl Accident.

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The Influence of Material Composition and Geometry of Heterogeneous Medium with Resonance Scattering on Concentration of Fast Neutrons in the Region Far from the Source

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This paper describes one option for production of high local neutron flux far from the source. Energy dependency of neutron scattering cross-section on some nuclei has resonance behavior. Below the resonance, there is a deep minimum of scattering cross-section resulting from interference of resonance and potential scattering. If slowing-down neutron gets energy corresponding very small scattering cross-section, it can propagate over large distance about several meters without interaction with medium nuclei. Therefore, conditions for selection of high-energy neutrons emitted by reactor or any other source and moving in required direction are investigated in the paper. Research described in the paper focuses on various impact factors (material composition, geometry) for neutron irradiation concentration and achievable neutron flux limits.

Key Words: Intensive Fast Neutron Flux, Resonance Scattering.

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Code VYBROS-3.1 for Evaluation of Consequences of Atmosphere Radioactive Release

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Code VYBROS-3.1 is used for evaluation of consequences of short and long radioactive release in the course of NPP operation. It's used the Gaussian model of atmospheric dispersion with acceptable errors for distance about 20 km from point of release. Code VYBROS-3.1 is the tool *for engineering calculations*, which used to provide radiation safety for stuff and population (simulation of the radionuclide migration in the atmosphere, evaluation of the terrestrial contamination and doses for population due to external and internal irradiation).

Key Words: Short and Long Release of Radionuclides, Calculation of Contamination with Radionuclides for Air and Soil, External and Internal Irradiation, Doses for Population.

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Diffusion and Thermal Emission in Mo-W Emitters of Electrogenating Channels

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The interdiffusion of W, Mo, and Nb in the samples of bimetal emitters of electrogenerating channels after reactor irradiation and after thermal testing was studied. The work function from the working surfaces of the emitter was measured also. The studies were performed on the microprobes MAR 2 and MAR 4, thermionic microscope and other analytical instruments.

Key Words: Thermionic Nuclear Reactor, EGC, Emitter, X-ray Spectral Microprobe, Thermionic Microscope.

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Non-Raster Methods of the Materials Surfaces Study

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The authors investigate methods of obtaining true-color cathodoluminescent images applying electron microprobe of diameter $\sim 2,0 \cdot 10^{-4}$ m to study the natural zircons and rough radioactive materials. The results are compared with black and white mode and colored mode of cathodoluminescence. All methods give the same images which show an inner structure and zoning of zircons. The surfaces images of anode of the nuclear electric generation channel (EGC) patterns are shown. These images are obtained as a result of irradiating surface patterns by a wide electronic beam. The images show the place of EGC electrodes contact after long reactor irradiation and anode surfaces condition as well.

Key Words: True-Color Cathodoluminescence, EGC Matter Imaging.