

Abstracts

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On the Issue of Nuclear Power Unit for Arctic Choosing

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The possibility of practically non-serviced reactor facility creation with thermoelectric generator or Stirling engine, 1 to 500 kWe capacity and up to 5—10 years or more life time is demonstrated. The facility is designed for the hard-to-reach Arctic territories development. The possibilities of integral design configuration of a low power high-temperature reactor facility with a graphite moderator with natural circulation of the fuel salt on the base of LiF—BeF₂—UF₄ solvent and the intermediate coolant 2LiF—BeF₂ are considered.

Key Words: Stirling engine, natural circulation, graphite moderator, molten-salt nuclear reactor, structural materials, intermediate coolant, fuel salt.

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Nuclear Power Plant for Forest Fires Extinction and Strengthening of Flood Defence

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Possibility of new ways of forest fire and floods fighting is considered in the article. This possibility is provided by means of energy-intensive measures with using of nuclear power plants. Using of nuclear power plants allows bringing large energy resources to produce liquid nitrogen. Liquid nitrogen can be used in remote region as main component of fire fighting and strengthen of hydraulic structures which prevent floods. To solve these problems a cryogenic mobile complex is proposed. In case of its allocation in dirigible it can quickly move towards dangerous places, and effectively stop negative nature occurrences, minimizing its scale and damage.

Key Words: forest fires, nuclear power plants, liquid nitrogen, cryogenic system, flows, protective constructions

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On the Regulatory Framework for the Low Power Nuclear Facility on the Floating Vehicles

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Discussed is the necessity for development of the specialized regulatory framework for nuclear power systems of low power on the floating vehicle, which will be optimal in respect to technical solutions for local consumers in the coastal regions. This regulatory framework shall be based on the existing norms and requirements of nuclear power engineering. The existing floating nuclear power plant “Academician Lomonosov”, built on the basis of the Shipping Register, can not be applicable for serial production for this sector of small-scale power generation.

Key Words: local nuclear power, floating nuclear power plant (npp), plant-manufactured, combination of refuelling with the repair cycle at the plant.

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**Measurements of the Reactor LR-0 Neutron Power in Absolute Units
by Modernized Correlation Analysis Method**

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The LR-0 neutron power was measured in the absolute units by the modernized correlation analysis method. The fluctuating component of the ionizing chamber record is separated on the average record level. That component is amplified by the U7-6 amplifier and transferred to the intermediate storage by cycles of 16 384 numbers. These data are used for calculation of the correlation function and desirable reactor parameters. The cycles are repeated until the acceptable accuracy of the experimental reactor parameters will be reached.

Key Words: absolute power, modernized correlation analysis method, LR-0 reactor.

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**Model of Dynamics of the IBR-2M Pulsed Reactor with Temperature and Power
Fast Feedback Effects**

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The paper contains description of the dynamics model for the IBR-2M pulsed reactor of periodic operation with a dedicated temperature feedback formed by the average temperatures of the fuel and coolant. It is shown that in this case the feedback reactivity cannot be described only by these components. Therefore, power feedback (the dependence of feedback reactivity on power) was also introduced in the model. The model uses discrete transfer functions that reflect the dynamics of pulsed processes in the reactor. Feedback parameters were experimentally estimated. The model can be used to describe changes in the energy of pulses in a wide dynamic range.

Key Words: pulsed reactor of periodic operation, IBR-2M, power feedback, temperature feedback, self-regulating regime, model dynamics, transient process.

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**Calculations of Two-Dimensional Spatial Kinetics Tests of the C5G7-TD Benchmark
with Positive Introduced Reactivity by SUHAM Code**

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Description of tests with positive introduced reactivity were added in last C5G7-TD benchmark specifications. The introduction of a positive reactivity is achieved by removing groups of control rods from the core. SUHAM code is used for calculation of the seven two-dimensional tests, differing in the speed at which control rod groups are removed and/or groups of control rods that are removed from the core. For each test, the time dependences of the following values are calculated: the total power of the calculated object, the power of the fuel assemblies, the local powers, the reactivity, the effective fraction of delayed neutrons and the lifetime of the delayed neutrons.

Key Words: surface harmonics method, neutron transport equation, system of codes SUHAM-TD, benchmark C5G7-TD, tests with positive introduced reactivity.

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Study of the Phosphorus Distribution Over the VVER-440 Pressure Vessel Weld

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The distribution of phosphorus in VVER-440 reactor pressure vessels (RPVs) welded joints was studied using trepans cut out from decommissioned VVER-440 RPVs of units 2 & 3 of Novovoronezh NPP (NVAES-2, 3). An analysis of the results is carried out taking into account the data for others standard VVER-440 welds. The characteristics of the phosphorus distribution over the weld are determined. The region of surveillance specimens cutting is characterized from the point of view of obtaining the conservative results of the assessment of radiation embrittlement.

Key Words: reactor vessel, VVER-440, surveillance specimens, phosphorus, weld, trepans, templates.

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Development of Heuristics to Improve the Speed of the Water Exchange Minimization Algorithm During Reactor VVER-1200 Power Control

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In order to solve the problem of the minimization of water exchange in the primary circuit of a VVER-1200 reactor operating in transient mode, we chose the dynamic programming method (DPM). However, this method is very expensive in terms of RAM and computing time. A heuristics is introduced for the DPM to decrease the computational costs. The introduction of the heuristics makes it possible to cut the inefficient branches of the DPM algorithm and to increase its speed without loss of precision. The temperature control of power reduces the amount of coolant removed from the primary circuit.

Key Words: VVER-1200, control, optimization, DPM, heuristic.

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Concerning the List of Dose-Producing Radionuclides in Airborne Discharges of NPPs

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The task of well-proved reduction of the list of normative and controlled radionuclides in airborne discharges of NPPs is one of the high-priority one in the field of regulation of materials, contaminating the environment. This article describes one of the possible ways of the solution of the above-mentioned problem. It is based on creating and analyzing of the list of radionuclides, which produce 99% or more of the dose from all radionuclides in the discharge, registered in NPP. The universal list of dose-producing radionuclides is established for 47 revised NPPs with WWER and PWR power units. It contains 15 radionuclides: ¹⁴C, ³H, ⁴¹Ar, ¹³¹I, ⁸⁸Kr, ⁶⁰Co, ¹³⁷Cs, ⁸⁷Kr, ¹³⁵Xe, ¹³⁴Cs, ^{110m}Ag, ^{85m}Kr, ⁹⁰Sr, ⁵⁸Co, ¹³³Xe.

Key Words: nuclear power plant, WWER type reactor, PWR type reactor, radionuclide, effective dose, airborne discharge, environment.