Abstracts
Journal "Problems of Nuclear Science and Engineering. Series: Physics of Nuclear Reactors"
issue No.1, 2013

UDC 621.039.17

Modeling of Heat Transfer in Geometrically Complex Environments with Volumetric Source

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Fuel elements obtained from the spent fuel are porous media with spatially varying characteristics. It is proposed in this work a hierarchical discrete structure for the numerical simulation of heat transfer in media with anisotropic geometry, which is characterized by both microscopic voids and macroscopic changes of the parameters. On the lower level of the structure the basic cell represent the local properties of the medium. The cells have a standardized interface that allows one to form three-dimensional nets. Different types of cells in the net represent macroscopic changes. The applicability of parallel processing is analyzed.

Key Words: Thermal Conductivity, Geometrically Complex Environment, Digital Networks, Parallel Computing.

UDC 621.039.17

Validation of Hald Approach in Assessing Tolerance

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It is analyzed the correctness of the approximate formula, which is widely used in evaluating the results of the regression analysis tolerances. It is shown that the approach is correct at widely used probability/significance level of 95/95. The conditions of applying the approach at more stringent requirements, such as 99/99, are formulated.

Key Words: Regression Analysis, Tolerance Limit.

UDC 519.85+614.876+621.039.5

Parallelizing of the Electron Transport Monte Carlo Simulation Using Code Package BRAND and Software Library PARMONC

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The Monte Carlo simulation by individual collision technique precision-oriented to solve the electron transport problem in a real geometry using information about the interaction of radiation with matter directly from the evaluated nuclear data files are considered. The comparison results of BRAND calculations with calculations by similar programs including the problem of radiation medicine are given. A comparative analysis of BRAND calculation results before and after parallelizing using the PARMONC library is held.

Key Words: Computer Simulation, Electron Transfer, Monte Carlo Method.

UDC 681.518.5

About Parameters Optimization Method of Dynamic Ship Reactor Model for the Purposes of On-Line Diagnostic Engineering

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It is offered the parameters optimization method of dynamic ship reactor model on the basis of the sensitivity analysis of model to its parameters, of the simulating data, and of the real phenomena of the object, that are received on the dock trials by measurement system.

Key Words: Parametrical Diagnostics, Dynamic Model, Analysis of Sensitivity.

UDC 621.039.54

Advanced Fuel for VVER and Fast Power Reactors

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Various options of improving oxide fuel UO_2 are analyzed, and possibility and expediency of using dispersion and MOX fuel in VVER reactors are considered. For fast reactors, a comparative analysis of advantages and drawbacks offered by advanced nitride and metal fuel relative to MOX fuel is made. It is noted that at properly chosen design parameters of fuel elements with nitride fuel and helium sublayer, the maximum fuel burnup can go up to 10…12 % of heavy atoms. The state of the art in development of U and (U + Pu)Zr metal fuel in Russia suggests that this fuel type can be used as a blanket region material and as individual inserts in heterogeneous cores of fast reactors.

Key Words: VVER, Fast Reactors, Oxide Fuel, Dispersion Fuel, Mixed-Oxide Fuel, Mixed Nitride Fuel, Metallic Fuel.

UDC 621.039.54; 543.427.34; 537.53

The Effect of Irradiation on the Structure of Carbonitride Fuel

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Samples of U-Zr-C-N nuclear fuel were investigated. Duration of irradiation of fuel rod from which samples were cut was 8 300 hours; about 30 years have passed after irradiation. The microstructure of the fuel samples was investigated by scanning electron microscopy. Three annular zones along tablet radius are clearly distinguished in all samples: middle, inner and outer zones, characterized by different porosity; technological pores (size 1…5 μm) and radiation pores (10…20 nm) are presented. The inclusions of 1…2 μm were found in the bodies of grains. The gap between cladding and fuel was investigated. The gap between fuel and cladding is not overgrown during irradiation. Its width at different places is between 50 and 100 μm. Layer of re-condensed fuel of thickness 40…60 μm in the form of columnar crystals is presented on inner surface of cladding. The distribution of uranium in the re-condensed fuel-cladding interface was studied by X-ray analysis.

Key Words: Nuclear Thermal Propulsion Reactor, Carbonitride Fuel, X-ray Analysis, Scanning Electron Microscopy.

Seminar "Physics of Nuclear Reactors"

The seminar "Physics of Nuclear Reactors" is working.in the NRC "Kurchatov Institute" since 1999 under the direction of the head of the Nuclear Reactors Physics Department S. M. Zaritskiy.

By the time of this journal issue there were 122 seminar meetings, the theme of which is not limited by the fact stated in seminar title.

The speakers and participants of the seminar are the scientiests from NRC KI and other Institutions.

The information about the seminar is located on the site of NRC "Kurchatov Institute" (www.nrcki.ru), and is sending to the participants.

This issue contains the information about 110 – 122 seminar meetings and abstracts of reports provided by speakers.