Summaries

UDC 620−4:621.039

Filippov G.A., Nazarov O.I., Belyaev L.A.
WAYS OF IMPROVING STEAM TURBINE INSTALLATIONS AT THE NUCLEAR POWER STATIONS

The article considers the possibility of increasing the efficiency of NPP steam turbine installations including the ways of improving transfer capacity of the turbine aft stages. The analysis of variants for constructive implementation of a flow path in a low pressure cylinder is introduced. The authors propose the unique structure of the steam turbine installation using double moisture separation. It allows increasing the steam turbine installation efficiency to 40...41 %.

UDC 621.039.5:004.942

Shamanin I.V., Gavrilov P.M., Bedenko S.V., Martynov V.V.
OPTIMIZATION OF NEUTRON-PHYSICAL PARAMETERS FOR SPENT NUCLEAR FUEL STORAGE SYSTEM

The authors carried out the calculation investigations of the neutron-physical parameters of dry storage systems for spent nuclear fuel in the reactor RBMK-1000. Systems and access circuits parameters at dry storage of spent nuclear fuel are optimized due to its alternate layers with different burn up and cleaning depth.

UDC 541.64:547.759.32

Loginov V.S., Simonova O.S.
THE APPROXIMATE GENERALIZED SOLUTION OF A BODY THERMAL STATE AT SMALL FOURIER NUMBERS (Fo<0,01)

The authors obtained simple analytic solutions at Derichlet's and Newton's boundary conditions useful for calculating the initial stages of thermal processes in classical form bodies (plate, cylinder, ball).

UDC 662.815.4

Zavorin A.S., Kazakov A.V., Tabakaev R.B.
THE EXPERIMENTAL PREREQUISITES TO TECHNIQUE OF PRODUCING FUEL BRIQUETTES FROM PEAT

The article introduces the results of experimental researches of peat fuel briquettes intended for burning in layer furnace units. Thermotechnical and strength characteristics as well as the elemental composition of the obtained briquettes are given.

UDC 662.76

Kuznetsov G.V., Kulesh R.N., Polsongkram M.
INCREASING ENERGY EFFICIENCY OF THERMAL CONVERSION IN WOODY BIOMASS

The authors carried out the experimental researches of thermal decomposition regularities for six types of woody biomass in temperature range to 600 °C at different rates of material heating. It was ascertained that the yield of solid (carbon black), liquid (biofuel) and gaseous (biogas) products depends slightly on heating rate. The results obtained are the base for developing the measures for increasing energy efficiency of engineering procedures of biomass thermal conversion. The authors determined the dependence generality of thermal conversion depth on temperature and heating rate.

UDC 536.46:532.517.4

Askarova A.S., Bolegenova S.A., Maksimov V.Yu., Bekmukhamet A.
APPLYING 3D MODELING TO STUDY THE HEAT AND MASS TRANSFER PROCESSES IN COMBUSTION CHAMBERS AT ACTUAL ENERGY FACILITIES

The authors have studied the heat and mass transfer processes at pulverized coal combustion by the example of combustion chamber BKZ-75 at Shakhtinsk thermal power plant applying the 3D modeling based on solution of differential equations of turbulent reactive flow. The distributions of total velocity vector components in different sections of a combustion chamber are obtained. The article introduces the combustion chamber height dependence of total velocity vector. Temperature profiles and its distribution in the combustion chamber height are obtained. The minimum and maximum values of the given variables are determined. The article demonstrates the dynamic in changing these characteristics in the volume of the combustion chamber under test.

UDC 621.643

Polovnikov V.Yu., Khabibulin A.M.
NUMERICAL SIMULATION OF HEAT TRANSFER IN WALLINGS OF RESERVOIRS FOR STORING FREEZING CONSIDERING THERMAL INSULATION FROST PENETRATION

The article introduces the results of numerical analysis of cooling loss owing to moistening and further frost penetration of thermal insulation layer in the reservoirs for storing freezing. The scales of increasing heat gains are shown and the possibility of neglecting heat transfer nonstationarity is proved.

UDC 621.311.001.57

Smirnov D.K., Galashov N.N.
SOFTWARE SYSTEM FOR VISUAL MODELING OF CIRCUITS FOR HEAT-AND-POWER ENGINEERING UNITS

The authors developed the software system for visual modeling of circuits for heat-and-power engineering units based on the object approach. It allows automating circuit simulation using ready-made components of equipment and relations and developing new components and changing mathematical models of any objects at any stage of simulation.

UDC 532.529.2

Glukhov A.F., Demin V.A., Malgacheva I.A., Popov E.A.
THERMAL CONVECTION OF FERROMAGNETIC FLUID IN NARROW CHANNELS

Thermal convection of magnetic fluids was experimentally and theoretically studied based on kerosene in narrow coupled channels with high conductivity boundaries. The three-component model was proposed for explaining complex dynamic behavior of the convective system in the range of low supercriticality. According to this model the magnetic fluid should be considered as colloidal solution with ferro-particles and carrying liquid complex in its molecular composition. It was shown that the nature of nonlinear convective oscillations of magnetic fluid near the mechanical balance threshold is determined by thermal-diffusion separation of kerosene components in channel section.

UDC 621.314

Serikov A.V., Kuzmin V.M.
ELECTROMAGNETIC PROCESSES IN TRANSFORMER TYPE HEATING ELEMENT FOR HEAT SUPPLY SYSTEMS

The authors propose the mathematical model for studying the electromagnetic processes in transformer type heating element. The computer model is implemented in MATLAB. The article introduces the harmonic analysis results. The authors determine the anharmonicity coefficients for stress curve while turning on the device tested into restricted power network.

UDC 621.3:536.7:678

Khalin M.V., Vostrikov E.I.
ENERGY-SAVING COMPOSITE ELECTRIC HEATERS OF ANTI-ICE SYSTEMS

The authors analyzed the existing anti-ice systems, determined their advantages and disadvantages. The article sets the problems of studying plate and bulk multielectrode composite electric heaters based on butyl rubber in anti-ice systems for wide application. The complex of electrophysical tests was carried out. The latter determined the conditions of operating procedures for producing electric heaters with autostability and self-adjusting effects. The authors proved the opportunity of long-term operation of the electric heaters in damp and aggressive environments and appropriateness of their use in anti-ice systems.

UDC 621.374.4/5:517

Vaynshteyn R.A., Kolomiets N.V., Shestakova N.V.
THE UNIVERSAL CRITERION FOR CALCULATING THE PARAMETERS OF NONLINEAR OSCILLATING CIRCUIT WITH ALTERNATING PARAMETER

It is shown that fulfilling the equality condition of a period average value of parametric vibration natural frequency allows obtaining the ratios between the electromagnetic and design parameters for a frequency demultiplier on the boundary of occurrence of half-frequency vibrations and in steady state conditions. The ratios obtained allow making the precise calculations.

UDC 621.311.42

Manusov V.Z., Morozov P.V.
THE POWER EQUALIZATION TECHNIQUE ON THE SECONDARY WINDINGS OF SCOTT-TRANSFORMERS

The authors propose to apply the electron device for equalizing power on the secondary windings of transformer converter based on Scott circuit. The device based on thyristor bridges with an average point controlled by multilevel pulse-width modulation is simulated. The complete current equality in secondary windings of Scott-transformer is confirmed. It supports the full current symmetry in three phase grid.

UDC 621.316

Vedernikov A.S.
THE ANALYSIS OF SPECIFIC CHARACTER OF INTERNAL OVERVOLTAGE IN DOUBLE CIRCUIT TRANSMISSION LINES 35–330 kV

The author analyses the specific character of occurrence and behavior of switching overvoltage in double circuit transmission lines. The article introduces the classification of inner overvoltage by the sources of their occurrence. The expressions allowing determining the overvoltage wave parameters are given. The author provides recommendations on the necessity of considering the influence of neighbor chain in double circuit line when calculating the switching overvoltage value.

UDC 621.316.925.4:519.21

Chan Khoang Kuang Min, Shmoylov A.V.
TECHNICAL EFFICIENCY OF DISTANCE RELAY PROTECTIONS OF HIGH VOLTAGE TRANSMISSION LINES

The article considers the algorithm for estimating technical effect and technical efficiency of line distance relay protection. The authors substantiate the components of these expressions: short circuits on protected line as a possible effect and losses: refusal to operate of unnecessary and false actions.

UDC 621.373.1

Rybin Yu.K.
APPLYING THE SYMMETRY PRINCIPLE WHEN SYNTHESIZING THE STRUCTURES OF ELECTRIC SIGNAL GENERATORS

The possibility of applying the symmetry principle when synthesizing the electric signal generators and measurement converters is discussed. It is shown that such systems are synthesized by converting certain system element operator: complex transmission, amplitude-frequency, phase-frequency or amplitude characteristics. The proposed technique is shown to synthesize the oscillating systems of electric signal generators however it may be applied to analyze any cyclic processes.

UDC 621.317.727.1

Kim V.L., Pruglo V.I., Merkulov S.V., Cheburenko D.S., Ivanov M.L.
PRECISION LOW-FREQUENCY GAUGES OF NATIONAL PRIMARY STANDARD FOR A UNIT OF ELECTROMAGNETIC WAVES ATTENUATION IN THE FREQUENCY RANGE FROM 0 TO 178 GHz

The developed six- and seven decade standard inductive voltage dividers with error $3 \cdot 10^{-5}$ % on 1 kHz and 0,01 % on 100 kHz were described. The dividers as primary attenuation standards, and lock-in amplifier with 10 nV sensitivity ensure the attenuation unit reproduction in the frequency range from 0 to 178 GHz with the highest accuracy.

UDC 621.317.444

Baranov P.F., Muravyev S.V., Ogay V.E., Uchaykin S.V.
FLUX-GATE MAGNETOMETER FOR MEASURING MAGNETIC INDUCTION TO 1 nT

The article introduces the experience in developing one-component magnetometer based on a miniature planar flux-gate sensor for measuring magnetic induction in the range from 10 mT to 1 nT and supporting operation of superconducting quantum computer. The authors describe the method for producing the flux-gate sensor and the operational principle of signal conditioning from the sensor.

UDC 621.382

Petrosyan O.A., Buniatyan V.V., Travadzhyan L.M.
THE DEVELOPMENT AND SIMULATION OF FERROELECTRIC MEMORY CELL

The authors considered the comparative characteristics of ferroelectric memory cells with the most wide spread memory devices. A new multisource structure of ferroelectric memory cell was developed. Its operation as well as cell modeling based on the software package HSpice were analyzed. The authors studied the main characteristics of multisource structure at various combinations of memory cell parameters according to the design technique of a storage with the optimized ratio of bit-line capacitance and ferroelectric condenser.

UDC 681.5

Filipas A.A., Ageev A.Yu., Ageeva E.V.
AUTOMATIC COMPLEX FOR INVESTIGATING THE FEATURES OF RADIATION-RESISTANT PIEZOELECTRIC SENSORS

The article describes the automatic complex intended for studying static and dynamic characteristics of piezoelements at external actions variations (temperature, external steady state force, etc.). The complex consists of mechanical section, system for setting the external electric signals, measuring and control systems, computer controlling system and data base. The mechanical section uses the principle of hydrostatic forming force based on stepping motor. The computer controlling program and data base allow accumulating, processing, visualizing and storing the results obtained.

UDC 621.373.52

Pushkarev V.P., Titov A.A., Zharsky V.D., Zhirnov V.P., Kochumeev V.A., Pelyavin D.Yu., Shukhlov I.V.
PULSE GENERATOR ON GUNN DIODE WITH HIGH OUTPUT STABILITY

The article introduces the description of microwave generator consisting of the exciter and the resonating chamber with Gunn diode 3A750G. The authors minimized the influence of disturbing factors change on generator characteristics due to the unique circuit solution of voltage stabilization system of Gunn diode excitation.

UDC 621.373.8

Gubarev F.A., Fedorov V.F., Fedorov K.V., Evtushenko G.S.
CONTROL OF CuBr-LASER GENERATION ENERGY

The article demonstrates the possibility of controlling the energy for generating CuBr-laser with solid-state switch by introducing additional pulse with adjustable amplitude before the main excitation pulse. The increase of additional pulse amplitude allows decreasing energy in generation pulse both partially and to the total suppression. The amplitude modulation of generation pulse is implemented by low-frequency harmonic signal.

UDC 621.313.12

Nosov G.V., Pustynnikov S.V.
INDUCTANCE-CAPACITANCE GENERATOR OF POWER PULSE CURRENT FOR SUPPLYING ELECTROPHYSICAL INSTALLATIONS IN FREQUENCY MODE

The article considers the application of inductance-capacitance generator of power pulse current for supplying electrophysical installations in frequency mode. The inductance-capacitance generator consists of feeding synchronous electric machine generator operating in short-impact mode. The winding of the latter with alternating electromotive force and two groups of thyristors is used for accumulating energy in magnetic field of the transformer primary winding. The capacitor bank is connected in parallel to the transformer primary winding accumulating energy. The secondary winding of this transformer is connected by the third group of thyristors to the electrophysical installation. The article introduces the equations and the results of calculation in the form of time characteristics and tables. The magnitude of bank capacity is optimized in the range from one to ten values of resonant capacitance of the transformer primary winding. The capacitor bank occurrence increases in 5...10 times the generator power; the maximum energy in the bank is 10 times lower than the maximum stored energy in the magnetic field of the transformer primary winding. At generator long-term operation the pulse current repetition frequency in the load may exceed one tenth of the alternating frequency of sinusoidal electromotive force in the electric machine generator.

UDC 621.314.5

Tatur V.V.
HIGH-VOLTAGE PULSE GENERATORS WITH OUTPUT VOLTAGE DOUBLING

The article introduces the high-voltage pulse multi-stage generators with output voltage doubling made by Arkadyev–Marks circuit and the circuit with voltage inversion proposed by R. Fitch and V. Govell. The feature of generator circuit design is the exchange of charging resistors by charging diodes and supply voltage connection through the total inductance. Such design allows obtaining the double pulse amplitude on the load as well as minimizing power loss at storage capacitors charge.

UDC 628.9.03:537.533.79:621.311.62.049.77.002

Ivanov A.V., Razorina Yu.K., Semenov S.M., Fedorov A.V.
ENERGY-SAVING DRIVER FOR LED SOURCES

The driver for supplying LED sources for optical radiation is developed. The article describes its structural and functional diagrams. The engineering data and indices of the driver with the design capacitance of 150 W are introduced.

UDC 621.314

Krasnobaev Yu.V., Ivanchura V.I., Kapulin D.V.
MULTIMODE PULSE VOLTAGE REGULATORS WITH THE CONTROL BY DISCRETE VALUES OF STATE VARIABLES

The law of controlling pulse voltage regulator of reducing type by discrete values of state variables was considered. The authors developed the microcontrolling device for controlling the voltage regulator of reducing type supporting minimization of transient period. One- and two modular pulse voltage regulators with the developed control device were modeled.

UDC 621.311

Dementyev D.F., Kazantsev Yu.M.
OUTPUT BUS IMPEDANCE CORRECTION IN SPACECRAFT POWER SUPPLY SYSTEM

The authors study the dependence of frequency response characteristic of output impedance in spacecraft power supply system on the type of controller, conversion frequency, the amount of converter phases. The Strategy for controlling pulse voltage regulator and ways of impedance minimization are proposed. The latter include the growth of switching frequency, application of multi-phase conversion and equal phase current sharing, the increase of output filter capacitance.

UDC 621.314

Shinyakov Yu.A., Shurygin Yu.A., Arzhanov V.V., Teushchakov O.A., Osipov A.V., Arzhanov K.V.
STAND-ALONE PHOTOVOLTAIC POWER SYSTEM

The article introduces the results of designing the stand-alone photovoltaic power system with maximum output power of 1,5 kW with extreme power control of solar panels and their automatic Sun tracking.

UDC 681.5.08

Gyunter S.V., Sheffer N.A., Dambaev G.Ts., Votyakov V.F.
OPTO-ELECTRONIC DIAGNOSTICS OF TRACHEOBRONCHIAL DYSKINESIS

The authors propose the method for diagnosing tracheobronchial dyskinesis using opto-electronic registration system. For diagnosing this disease the opto-electronic system functioning by optical detection principle is used. The investigation is carried out by probe introduction into tracheal and primary bronchus lumen. The result is recorded on monitor in the form of diagram; its amplitude depends on organ lumen change. The method efficiency is tested on the experimental model of tracheobronchial dyskinesis.

UDC 62-83:621.313.333

Fedorenko A.A., Lazovsky E.N., Pechatnov M.A.
ASYNCHRONOUS MACHINE DYNAMIC EQUATIONS INVARIANT TO ROTATION VELOCITY OF THE COORDINATE SYSTEM

The article introduces two versions of asynchronous machine mathematical models invariant to rotation velocity of the coordinate

system of. Such model software features conditioned by division operators are shown and their comparative evaluation with the models in Cartesian coordinates is given. The authors note the opportunity of using the resultant vector modules of three-phase variables and their phase shifts relative to each other as the asynchronous machine state variables for developing new structures of automate induction motor drives.

UDC 62-83:621.313.333(316.71)

Vdovin V.V., Pankratov V.V.
SYNTHESIS OF ADAPTIVE COORDINATE OBSERVER OF SENSORLESS INDUCTION MOTOR DRIVE

The authors propose the method of synthesis and the structure of global stable algorithm for current identification of unmeasured coordinates for sensorless induction motor drive, namely, for reference vector of flux linkages and rotor electric rotating speed, as well as the algorithms for its adaptation to resistance variations. The article describes the calculation technique of adapter parameters. The simulation results are presented.

UDC 621.3.07

Grigoryev A.V.
CONTROLLING THE ELECTROMAGNETIC TORQUE OF THREE-PHASE INDUCTION MOTOR

The article introduces the model of three-phase induction motor expressed explicitly in terms of phase linkage of stator and rotor windings. The system for controlling electromagnetic torque of induction motor is synthesized. It possesses rapid response and low implementation complexity. The control system is tested on physical and computation models of induction motor drive.

UDC 621.313.8

Kokov E.G., Zhibinov A.S., Geynts E.R., Tsekhmestryuk G.S.
MAGNETIC FIELD AND ELECTROMOTIVE FORCE OF QUICK-RESPONSE MAGNETO-ELECTRIC MACHINES

The authors have obtained the analytic expressions for calculating the excitation field in the center of the machine active length where the field is accepted as plane-parallel. It allows determining rather precisely the excitation electromotive force in direct part conductors and in conductors of end winding with certain approximation.

UDC 62-83

Zavyalova O.Yu., Kazantsev Yu.M.
SYNTHESIS OF REGULATOR OF FLYWHEEL ELECTROMECHANICAL EXECUTIVE SETTING

The authors have developed the simulation model of electromechanical executive setting. This model use allows studying the operational modes and optimizing the control strategies supporting optimal operation of the system. The method for synthesizing current regulator is proposed. The essence of this method is in predicting pulse component of power circuit current. This component allows increasing the quality of adjusting ac electronic motor torque in a wide range of rotation frequency at decrease of dead band and increase of accuracy.

UDC 621.315

Kazakov A.V., Trufanova N.M.
NUMERICAL INVESTIGATIONS OF STRATIFIED FLOW MODES AND THE TECHNIQUE FOR CONTROLLING THE EXTRUSION APPLICATION OF MULTILAYER INSULATION

The article introduces the main principles for controlling molding of multilayer polymer insulation based on numerical solution of mathematical model of the process tested. The authors stated the mathematical model of multilayer flow of quasi-viscous polymer melts.

UDC 621.315

Subbotin E.V., Shcherbinin A.G., Trufanova N.M.
NUMERICAL INVESTIGATION OF POLYMER FLOWING AT PHASE TRANSFER IN EXTRUDER SCREW CHANNELS WHEN PRODUCING PLASTIC INSULATION

The authors have carried out the numerical investigation of operation of the extruder with screw classical geometry. The article introduces the diagrams of pressure distribution, minimum, average and maximum temperature change over the channel length. The patterns of: plug form change; temperature field distribution and velocity component in the extruder channel section are given. The head-flow characteristics are formed.