Ivanovo State Power Engineering University

Vestnik of Ivanovo State Power Engineering University (Vestnik ISPEU)

The Journal has been published since 2001 ISSN 2072-2672 Issue 4 /2010

The issue is prepared by:

Responsible people for the issue: A.V. Moshkarin, V. A. Shuin, V.A. Poletaev, A.R. Kolganov, F. N. Yasinskiy, A.A. Belov, A.M. Karyakin

Chief of Educational and Scientific Literature Publishing Office **S.V. Klyunina**
Technical Editor **N.V. Koroleva**
Editor **S.M. Kotkova**

CONTENT

The Journal «Vestnik of Ivanovo State Power Engineering University» is included in the List of Leading Reviewed Scientific Journals and Publications, which are approved by the State Commission for Academic Degrees and Titles for publishing the main scientific results of the dissertations on the candidate and doctoral degrees.

The information on published articles is included into the Russian Science Citation Index system according to the Agreement №29-05/08 dated May 20, 2008 with JSC ltd. «Scientific Electronic Library».

HEAT AND POWER ENGINEERING

UDK 621.321

EXPERIMENTAL DETERMINATION OF LOADING CORRECTION GRID FOR CHANGING PRESSURE OF EXHAUSTED STEAM IN CONDENSER OF THE TURBINE TP-115/125-130-1TP UTMZ

G.V. LEDUKHOVSKY, A.A. POSPELOV, M.Yu. ZORIN, Candidates of Engineering,
S.V. DOBROV, N.S. ASTASHOV, Engineers, E.M. ZORINA, Student

The authors present the results of actual tests of turbo-installation with the turbine Tp-115/125-130-1tp UTMZ located at Yoshkar-Ola Heat Power Plant 2. The purpose is to determinate loading correction grid for changing pressure of exhausted steam in condenser.

Key words: steam turbine, condensation structure, pressure of exhausted steam, actual tests of equipment.

UDK 621.165

THE PROBLEM OF OPTIMIZATION OF HEAT POWER PLANT EQUIPMENT TAKING INTO CONSIDERATION DELIVERY WATER DISTRIBUTION BETWEEN HEAT EXCHANGERS AND COMBINED METHOD OF ITS SOLUTION

V.P. ZHUKOV, E.V. BAROCHKIN, Doctors of Engineering, A.A. BORISOV, Post Graduate Student, S.A. PETROVANOV, Engineer.

The problem of optimization of heat power plant's equipment taking into consideration delivery water allocation between heat exchangers is formulated. A method of its solution is suggested. It combines the method of guided retrieval in multidimensional subspaces of heat and electrical loading factors and the method of coordinate retrieval between these subspaces. The latter takes into consideration limits to total load and to legitimate range of each unit parameters points.

Keywords: system analysis, bundled software, optimization.

UDK 621.311.22

INFLUENCE OF MAJOR FACTORS ON CCGT-325 MW POWER CHANGING

A.V. MOSHKARIN, Doctor of Engineering, B.L. SHELYGIN, Candidate of Engineering,
T.A. ZHAMLIKHANOV, Post Graduate Student

Analytical and graphic dependences of power unit static characteristics at various loadings of GT and external air temperatures are presented. The comparative analysis of CCGT-325 MW operating parameters in modes of a monoblock and two-boiler single-turbine unit is resulted.

Keywords: CCGT, gas turbo unit (gas turbine), outdoor temperature, coefficient of efficiency, electric power, HRSG, monoblock, two-boiler single-turbine unit.

UDK 681.3:62-52.621.311.25

THE NUMERICAL RESEARCHES OF THE STAGE OF START-UP OF BLOCK SCP ON THE SEPARATOR MODE USING MATHEMATICAL MODEL

A . VINOGRADOV, A . KISELIOV, Candidates of Engineering, A . A . MITYUSHOV, Engineer

This publication is a continuation of the article printed in release 3 of «Bulletin ISPU». Both publications are devoted to the questions of mathematical modeling of the power equipment and research of its working modes with the help of mathematical models with the example of kindling unit of power uniflow boilers SCP during a kindling on a separator mode. The given researches were spent for the power stations entering into Open Society «OGC-6» within the frames of perfection and expansion of possibilities of mathematical models of simulators.

Keywords: simulation, simulator, kindling mode, boiler.

UDK 621.184

PECULIARITIES OF INTERNAL CORROSION OF HEATING SYSTEMS

V.N. VINOGRADOV, I.A. SHATOVA, Candidates of Engineering, W.Q. AWAN, Post Graduate Student,
A.V. SHOVALOV, Engineer

The examples which highlight the arguments concerning the problem of quality standards of supply water and delivery water taking into account of using layers water-steam heaters and information about chemical control of water-chemical mode of heating systems are given in this article. The methods of increasing the information concerning internal corrosion of supply systems are offered.

Keywords: heating system, water-chemical mode, corrosion, chemical control.

UDK 534.24.001.573

ALGORITHM FOR SOLUTION OF RADIANT HEATING PREMISES SYSTEMS

V.V. BUKHMIROV, S.A. KRUPENNIKOV, Doctors of Engineering, Y.S. SOLNYSHKOVA, Post Graduate Student

The algorithm for calculation of heating systems with gas and electric infra-red radiators is developed. The example of record of system resolve-zoned equations describing process of radiative and convective heat exchange is given.

Keywords: microclimate parameters, mathematical model of radiation heating system, infrared projectors, methods of projectors placements.

UDK 681.3:62-52.621.311.25

COMPETITION OF COMBINED TEAMS OF OGK-3 OPERATING PERSONNEL

V.S. RABENKO, A .L. VINOGRADOV, A .I. KISELIOV, V.A . BUDANOV, Candidates of Engineering

The article contains the results of workmanship competitions of OGK-3 operating personnel on 300 megawatt unit simulator. The simulator was designed by Ivanovo State Power University and assigned for unit operating personnel and operating conditions investigation of power equipment.

Key words: simulator, simulation, power unit.

ELECTRICAL POWER ENGINEERING

UDK 519.217.2

ANALYSIS OF THE METHODS BASED ON THE THEORY OF COLUMNS FOR DEFINING RELIABILITY INDEXES OF ELECTROPOWER SYSTEMS SCHEMES

V.K. SLYUSHALOV, Doctor of Engineering, G.V. CHEKAN, Post Graduate Student

The authors compare the methods of reliability indexes definition, using transition and conditions graphs. The advantages and disadvantages of each of these methods are revealed, their application spheres are discussed.

Key words: reliability, columns, Markov's processes, topological method.

UDK 621.314.214

MODELLING OF Z-DIACOPTICAL MATRIX WITH REGARD FOR COMPLEX TRANSFORMATION FACTORS OF TRANSFORMER

N.P. BADALYAN, Doctor of Engineering, K.V. KHACHATRYAN, Candidate of Engineering

The question of modeling of the Z-diacoptical matrix with regard for complex transformation factor of transformer, functioning in separate branch of the scheme replacement is considered.

Key words: electroenergetic system, diacoptical, node, matrix, radial bound subsystems, turn ratio.

UDK 621.315

PROTECTING IMPULSE DEVICES OF THE ETL FAULT LOCATION FROM SIMULATING INTERFERENCE

A.L. KULIKOV, Doctor of Engineering, A.A. PETRUKHIN, Candidate of Engineering, A.S. SVECHNIKOV, Engineer

The algorithm of simulating interference compensation for the power line fault location device based on active probing is proposed. The method of estimating the effectiveness of the protection from interference is presented, as well as the calculation results of the field tests are discussed. The developed algorithm is applicable for existing and prospective impulse ETL fault location devices.

Key words: fault location transmission line, electromagnetic compatibility, protection reflectometer from simulating interference.

ELECTROMECHANICS

UDK 621.313

NUMERICAL MODEL OF SWITCHING COMMUTATOR MACHINES IN DYNAMIC MODELS

A.I. TIKHONOV, Doctor of Engineering, Yu.B. KAZAKOV, Doctor of Engineering, I.M. LASHMANOV, Senior Teacher

The authors developed the numerical model of switching processes of commutator machines in dynamic modes based on calculation results of magnetic fields with finite-element method.

Key words: switching, commutator machines, dynamic models.

UDK 621.318

NANOMAGNETIC LIQUIDS SEALERS FOR CHEMICAL REACTOR SHAFTS

M.S. SAYKIN, Candidate of Engineering

Nanomagnetic liquids sealers are intended for compacting the rotate shafts of chemical reactors. On the basis of the experiment results recommendations concerning selection of nanomagnetic liquids and construction materials of sealers are given.

Key words: sealers, nanomagnetic liquids, chemical reactor.

UDK 621.321

THEORETICAL PRECONDITIONS OF MECHANICAL ACTIVATION OF TECHNOLOGICAL LIQUID

E.V. KISELEVA, Post Graduate Student

The author considers the regulating questions of disperse systems characteristics. The special technology of preparing the technological liquids is offered. As a result it is possible to receive the high effective homogenized systems. The author gives the research results of technological liquids on degree of dispersion.

Key words: boundary lubricant layer, disperse systems, coagulation structure, stability, viscosity.

UDK 621.313

DEFINING FRICTION MOMENT OF MAGNETIC LIQUID SEALER WITH DISSIMILAR MAGNETIC FIELD ON BASIS OF NUMERICAL MODELING OF MAGNETORHEOLOGICAL FLUID MOTION

Yu.B. KAZAKOV, Doctor of Engineering, V.A. POLETAEV, Doctor of Engineering, T.A. PAHOLKOVA, Applicant

The authors determine the friction moment of magnetic liquid sealer on basis of the numerical modeling of the sharing the velocities of the current nano dispersion to magnetic liquid with nonlinear magnetic and rheology feature in condition of the inhomogeneous magnetic field in the sealer clearance. The algorithm and calculation results as well as an experimental unit for detecting friction moments of sealers are considered.

Key words: friction moment, magnetic liquid, magnetic rheology, unit.

UDK 621.316 .433

COMPUTER-AIDED DESIGN SYSTEM OF CURRENT LIMITING REACTOR FROM ALUMINIUM RIBBON

A.I. TIKHONOV, Doctor of Engineering, G.V. POPOV, Doctor of Engineering, A.V. IVANOV, Post Graduate Student

The structure and the principles of software modelling of the CAD reactor from aluminium ribbon are considered. The major principle of construction is the componental integration of modules. The satisfying coincidence of testing calculations results with the experiment is received.

Key words: CAD, current limiting reactor, lapping of an aluminium ribbon, mathematical modelling.

AUTOMATION CONTROL SYSTEMS

UDK 621.313

CURRENT REQUIREMENTS FOR ELECTRIC DRIVES OF PRODUCTION UNIT WITH NUMERICAL PROGRAM CONTROL

A.P. BURKOV, E.V. KRASILNIKYANTS, Candidates of Engineering, A.A. SMIRNOV, Post Graduate Student, N.V. SALAKHUTDINOV, Engeneer

The article is devoted to the analysis of modern standards for electric drives of production units with numerical program control systems. The authors suggest the set of qualitative and quantitative characteristics, which allow to get the comparative appraisal of electric drives.

Key words: standards for electric drive, machine-tool engeneering.

UDK 620.9.001.5

OPTIMIZATION OF CONTROL VALVE CHARACTERISTICS IN AUTOMATION CONTROL SYSTEMS

U.S. TVERSKOY, Doctor of Engineering, E.D. MARSHALOV, Engineer

The methods of control valve metering characteristics optimization are considered. The technique of algorithmic correction for nonlinear metering characteristics in automatic control systems is developed. This technique can be used for all types of throttling control valves and does not require any changes in design of an execution unit.

Key words: metering characteristics, control valve, algorithmic correction, automatic control system.

UDK 681.3:621.926

SPECIFIC FEATURES OF THE ALGORITHM ADJUSTMENT AND TESTING OF AUTOMATIC CONTROL OF NON-STATIONARY OPERATING MODES OF POWER SUPPLY PLANTS

A.V. GOLUBEV, Candidate of Engineering

This article contains the results of the experimental unit development at the laboratory «Testing Ground of Power Plant Automatic Process Control System» with the use of technological and APCS equipment simulation models running in the real-time environment and intended for the solution to complex and science-intensive tasks for the automation of thermal power plant units operating in starting and emergency conditions.

Key words: testing ground of the automatic process control system, automatic control algorithms, automation of starting and emergency conditions.

UDK 621.321

FUZZY LOGIC METHODS IN THE TASKS OF THERMAL PROCESSES AUTOMATION OF POWER PLANT

S.I. NOVIKOV, Candidate of Engineering, V.R. SHAHNOVICH, Post Graduate Student, A.V. SAFRONOV, Student

The article contains an overview of the fuzzy logic methods in industry. The perspectives of fuzzy control application for thermal processes automation are described.

Key words: fuzzy logic methods, thermal processes automation, power plant.

UDK 623.41.418

PROGRAM TOOLS FOR ELECTRIC DRIVE CONTROL

P.M. POKLAD, Post Graduate Student

The analysis of modern program tools for electric drive control is presented. Some features of software-hardware design of pulse phase locking electric drives are given.

Key words: pulsed-phase electric drive, software programs of management, regulators, drive.

METHODS OF MATHEMATICAL SIMULATION

UDK 681.326

ON STRENGTHENING AND NUMERICAL REALIZATION OF DEVELOPING FIELD MODEL OF FIRE

F. N. YASINSKIY, Doctor of Physics and Mathematics, O. V. POTEMKINA, Candidate of Chemistry,
S. G. SIDOROV, I. F. YASINSKIY, Candidates of Engineering

The calculation method is offered for the fire spreading field model. The methods, allowing to decrease the compute time and increase the results exactness are formulated.
Keywords: parallel programming, simulation, turbulence, sweep method.

UDK 614.841

MATHEMATICAL MODEL OF CRITICAL FIRE DURATION IN ADJACENT ROOM WITH FIRE SOURCE

S.S. LAPSHIN, Teacher

The article presents generalized equation allowing to define critical duration of fire in adjacent room. The decision is based on the integral model of fire. There is validation of the model with experimental and theoretical data. The equation is obtained with regard to not simplified solution of mass equation in a fire room.
Key words: modeling, fire, temperature.

UDK 519.673

USING CUDA ACCELERATORS SYSTEM FOR DECISION OF NAVIER–STOKES EQUATION IN «STREAM FUNCTION – CURL» VARIABLE

F. N. YASINSKIY, Doctor of Physics and Mathematics, A. V. EVSEEV, Post-Graduate Student

The article studies the possibility of modelling the viscous incompressible fluid motion described by the Navier-Stokes equations in the stream function from, using multiGPU CUDA system.
Key words: numerical simulation, CFD, Navier-Stokes equation, Poisson equation, Laplace equation, sweep method, CUDA, SLI, many accelerators, parallel algorithm.

UDK 681.31

DEVELOPING HYBRID APPROACH OF ENERGY CONSUMPTION PREDICTION WITH USING SUPERCOMPUTER ON ACCELERATORS

F.N. YASINSKIY, Doctor of Physics and Mathematics, A.V. NIKOLOGORSKAYA, Post Graduate Student

The article describes the possibility of constructing the hybrid method for predicting the electric energy demands using CUDA on a GPU-based supercomputer.
Key words: prediction, electricity consumption, time series, Wiener filter, neural network, evolutionary modeling, parallel algorithm, hybrid algorithm, CUDA technology, High-Performance Computing.

UDK 621.892

MODELLING OF FRICTIONAL BOUNDARY LAYER BY USING MOLECULAR DYNAMICS METHODS

V.A. GODLEVSKIY, Doctor of Engineering, E.V. BEREZINA, Doctor of Engineering, S.A. KUZNETSOV, Post Graduate Student

The problems of the mathematical description and computer molecular modelling of the lubricant in the frictional boundary layer were considered. Some models of the layers formed by lubricants of the various nature are presented. The parameters of supra-molecular self-organization of layer were calculated depending on the type of lubricant and shear conditions.

Key words: mathematical and computer modeling, boundary lubrication, supra-molecular self-organizing.

UDK 517.53

IMPROPER INTEGRALS WITH KERNEL cos *mx* AND RESIDUES

B.S. ZINOVYEV, Candidate of Physics and Mathematics, L.N. SOSNINA, Senior Teacher

The six new improper integrals with kernel cos mx are obtained by means of the single method of the theory of residues of the complex analysis. When proving theorem about residues, conditions of which for the given integrals are observed.

Keywords: improper integrals, kernel, residues.

UDK 511.6

ON DEVELOPMENT OF THE JACOBI-PERRON ALGORITHM

E.T. AVANESOV, V.A. GUSEV, N.P. KHARISH, Candidates of Physics and Mathematics

The authors consider an analogue of the Jacobi-Perron algorithm called the nearest integer algorithm which allows to solve the problem of calculating the basic units of algebraic fields.

Key words: multivariate chain fraction, Jacobi-Perron algorithm, cubic field.

COMPUTER SCIENCE AND INFORMATION TECHNOLOGIES

UDK 004.414

OPTIMIAL CARGO TRANSPORTATION PLANNING BASED ON GIS TECHNOLOGIES

S.V. KOSYAKOV, Doctor of Engineering, A.B. GADALOV, Senior Lecturer, K.A. ZHIDOVINOV, Student

The authors describe the results of the work on the creation of cargo transportation optimal planning software based on GIS. The variants of the implementation of search algorithms for optimal shipping plans, integration of software optimization, GIS and enterprise management systems, implementation of user interfaces in the systems of this class are described in the article.

Key words: optimal planning, cargo transportation, information system.

UDK 681.31

APPLYING GRAPHO-ANALYTICAL METHOD OF ANALYZING SUBJECT DOMAINS WHEN DESIGNING INFORMATION SYSTEMS

N.N. ELISAROVA, Candidate of Engineering, E.L. ARKHANGELSKAYA, Student

The article gives the brief classification of the analyzing methods of the subject domains used when designing information systems. The application of one of the approaches of the analysis based on decomposition of a subject domain and the analysis of interrelation of its elements is considered.

Key words: subject domains, information system, analyzing methods, unformalized, formalized, structural methods, graphic methods, analytical methods.

UDK 681.5

EXPANDABLE MODULE COMPUTER CONTROL SYSTEM BASED ON UNIX INTERPROCESSOR COMMUNICATION

B.A. STAROVEROV, Doctor of Engineering, V.V. OLONICHEV, Candidate of Engineering, M.A. SMIRNOV, Post Graduate Student

In the article the program system of the automatic control of the real object with the use of interprocess communication is considered. The given approach allows to remove all calculating load from one process to the set of specialized ones engaged with their own problem. It raises the level of flexibility and efficiency of programmable control of different levels of difficulty.

Key words: shared memory, semaphore, parametrical identification, method of the least squares, direct digital control, realization in C programming language, the programmable logic controller.

ECONOMICS

UDK 339.72

STRATEGY FOR MODELLING FINANCIAL TIME SERIES IN THE VALUE-BASED MANAGEMENT SYSTEM

I.A. ASTRAKHANTSEVA, Candidate of Economics

The approaches of developing financial strategy of company are identified in the article. It is proved that the linear deterministic approach to the company's strategy development limits its growth. The author developed the evaluation model of financial time series, taking into account the growth trend of capital invested, business cycles of company, noise effects and investment shocks.

Keywords: value-based management, simulation model, financial strategy, financial time series.

UDK 141.201

PUBLIC MOTIVATION OF PRIORITIES IN CONDITIONS OF ECONOMIC SYSTEM DOMINATION

I.V. ASTAFYEV, Candidate of Economics

The article gives the description and the general characteristics of instrumentation of public understanding of the target in context of their interactions with conventional Economics.

Key words: motivation, direction, institution, crisis, economy, target.

UDK 336.146

NEGATIVE TRANSFERS AS SOURCE OF FUNDING OF INTER-MUNICIPAL AGREEMENTS

O.A. GRISHANOVA, Doctor of Economics, G.A. PROKOPOVA, Post Graduate Student

The article deals with the issues of expansion of inter-municipal agreements, settlements with the aim of developing economic and revenue potential of municipalities, as well as encouraged to use «negative transfers» as a source of financing within the framework of inter-municipal agreements.

Key words: local government, local issues, expenditure commitments, inter-municipal cooperation, the negative inter-governmental transfers.