

Studies in Systems, Decision and Control 298

Vitaliy Babak  
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Artur Zaporozhets *Editors*

# Systems, Decision and Control in Energy I

 Springer

# **Studies in Systems, Decision and Control**

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# Preface

The concept of “energy” is meant here very generally and includes methods for obtaining and using various types of energy for the needs of human society. Energy is one of the foundations for the development of modern society. The effectiveness of solving social, economic and technical problems, as well as the anthropogenic transformations of nature, is largely determined by energy production and the scale of energy production.

Modern energy is not a separate industry, but it penetrates widely into other areas, in particular, chemical, transport, aerospace, construction, metallurgy, engineering, agriculture, etc. The energy sector is based on complex technical systems that are multicomponent, spatially distributed systems that during their operation are affected to a wide range of design and non-design thermomechanical loading conditions, the effects of aggressive fields and units, unauthorized influences (operator errors, terrorism, sabotage) and can reach various limit states.

Complex technical systems are characterized by complex non-linear interactions between their constituent elements, complex chains (scenarios) of cause–effect relationships between hazardous, probabilistic events and processes that occur during their life. These scenarios can be implemented over complex ramified scenario trees.

Ensuring the operational reliability, durability and safety of power equipment is a difficult task, which is associated with the organization of the reliability of control over the operation of power plants and ensuring optimal conditions for their operation. In this regard, we can distinguish a whole class of tasks related to the development of control systems, diagnostics and monitoring in the energy industry, which are presented in this book. Of particular relevance now is the use of UAVs in the energy sector.

Particular attention must be paid to the environmental consequences of the operation of energy facilities, the main of which is significant environmental pollution in large cities and industrial areas.

The development of environmental management information systems is the prerogative of the state, corporations and one of the main directions of the national informatization policy. A clearly debugged system of environmental monitoring

gives a general idea of the features of the current ecological state, the main directions of state policy in the field of environmental protection and the use of natural resources and environmental safety. The methodology and hardware–software tools for monitoring the state of the environment presented in the monograph are effective tools for supporting decision-making in managing the environmental safety of the atmosphere during its technogenic pollution.

This book presents a comprehensive look at the current state and prospects for the development of energy and related industries, formed by a team of authors from various scientific institutions of Ukraine. Among the authors of the book are employees of: Institute of Engineering Thermophysics of NAS of Ukraine, Institute of Electrodynamics of the NAS of Ukraine, Pukhov Institute for Modelling in Energy Engineering of NAS of Ukraine, State Institution “Institute of Environmental Geochemistry” of NAS of Ukraine, Institute of General Energy of NAS of Ukraine, National Aviation University, M. E. Zhukovsky National Aerospace University “Kharkiv Aviation Institute”, Ivano-Frankivsk National Technical University of Oil and Gas, Institute of Information Technologies and Learning Tools of NAES of Ukraine, Zhytomyr National Agroecological University, Zhytomyr Military Institute, National University of Life and Environmental Sciences of Ukraine, National University of Civil Defense of Ukraine, SE “state scientific and technical center for nuclear and radiation safety”.

A special contribution to the creation of this book belongs to the Council of Young Scientists of the Department of Physical and Technical Problems of Energy of the National Academy of Sciences of Ukraine.

Kyiv, Ukraine

Vitaliy Babak  
Volodymyr Isaienko  
Artur Zaporozhets  
Editors

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# Mathematical Approaches for Determining the Level of Impact of Ash-Slag Dumps of Energy Facilities on the Environment



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Oleksandr Popov , and Valeriia Kovach 

**Abstract** The article is devoted to the problem of the impact of storage sites of ash-slag dumps of enterprises of the fuel and energy complex on the environment. The processes occurring in ash dumps are described, specifically: evaporation of water with the formation of dry ash and dust particles in the territory of dry sites under the influence of wind and water infiltration (illuminated or even partially untreated) and the penetration of dissolved forms of toxic ash-slag components into groundwater and water bodies located beyond them. The features of the transport of pollutants in the zone of influence of ash-slag dumps are investigated. The processes and phenomena that are observed during the transport of dissolved substances in the soil are determined. The components of the process of wind erosion and the mechanisms of action on particles located on the surface layer of the territory of ash dumps are described. The factors determining the erosion of ash-slag dumps as an areal object are listed. A mathematical model of the migration of pollutants in soils is described, which consists of a system of differential equations in partial derivatives of the second order with variable coefficients. An analytical solution of these equations is presented with certain simplifications for the case of two-dimensional flow, when the aquifer can be considered horizontal, single-layer and homogeneous. A two-dimensional model of the migration of soluble components is considered, taking into account the gradient of the relief as the main reason for the movement of water in the surface layers of the soil.

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