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OPINION

on a dissertation for the award of the educational and scientific degree of "DOCTOR" professional field 5.2. "Electrical Engineering, Electronics and Automation" in the doctoral programme "Elements and Devices of Automation and Computing Technology"

at the Bulgarian Academy of Sciences, Institute of Robotics, Section "Robotics in Energy"

Author of the dissertation: MSc Eng. Desislava Ivanova Delcheva

Thesis topic: "Improving Energy Efficiency in Power Supply Systems"

Member of the scientific jury: Assoc. Prof. Dr. Eng. Lyubomir Simeonov Sekulov

1. General information and biographical data of the doctoral student

The doctoral student in the announced competition, MSc Eng. Desislava Ivanova Delcheva, completed her higher education in the period 2010-2016, acquiring the educational and qualification degrees of "Bachelor" and "Master" in the specialty "Electrical Power Engineering and Electrical Equipment" at the Technical University of Sofia "Todor Kableshkov".

By Order of the Director of the Institute of Robotics - BAS No. 92B/18.10.2024, MSc Eng. Delcheva was enrolled as a doctoral student in a free form of training in the section "Robotics in Energy" in the professional field 5.2. "Electrical Engineering, Electronics and Automation". Her scientific supervisor is Assoc. Prof. Dr. Eng. Ilian Hristov Iliev.

During her doctoral studies, she strictly follows her individual study plan, passing the required exams with excellent grades and actively participating in scientific forums, where she presents the main results of her research. During her studies in the section, the doctoral student worked thoroughly and consistently on the assigned scientific tasks and was involved in the execution of a scientific-research contract related to robotisation in the electric power industry, demonstrating high professionalism. By Order of the Director of IR-BAS No. 62/24.06.2025, she was awarded the right to defend her thesis upon completion of her studies.

MSc Eng. Delcheva has high computer literacy and good English language skills. Her personal qualities, professional training and in-depth knowledge in the field of electric power engineering and robotics are a significant contribution to the successful development of her dissertation, which focuses on a topical and promising scientific topic.

Professionally, MSc Eng. Delcheva holds the academic position of "assistant professor" at the Mining and Geology University "St. Ivan Rilski" - Sofia in the period 2021-2024, and since 2024 she has held the same position at the Institute of Robotics "St. Apostle and Evangelist Matthew" at the Bulgarian Academy of Sciences, Sofia.

2. General description of the dissertation paper

The dissertation consists of an introduction and four chapters, each of which reaches certain conclusions. The total volume of the dissertation is 175 pages, containing 112 figures, 42 tables and 235 mathematical formulas. The doctoral student's contributions, information and list of publications on the topic of the dissertation are presented accurately and clearly. The dissertation refers to 116 literary sources of information.

The doctoral thesis is devoted to issues of high relevance and practical significance, stemming from the leading role of electricity supply in the development of the industrial sector and in ensuring sustainable social life in modern urbanised areas. The growing dependence of the economic efficiency and society on uninterrupted and reliable electricity supply requires indepth research into the factors affecting its efficiency and sustainability.

In this context, the proper functioning of electricity systems and in-depth knowledge of the problems associated with their operation are the basis for increasing reliability and minimising accidents. Such research is crucial for improving the criteria for power supply quality, which is directly related to both energy security and the sustainable development of society and industry.

Chapter One examines the main guidelines of the research process, the characteristics of electrical loads and load schedules, as well as the methods for their statistical processing. Indicators such as load factor, maximum, demand and simultaneity are analysed. At the end, conclusions are drawn about the need for a statistical approach and critical analysis of capacities in power supply systems.

Chapter Two presents methods for assessing power and electricity losses, both conventional and based on the theory of experimental design (TED). Quantitative assessments of losses by sector are made and their relationship to the parameters of electrical networks is justified. The importance of probabilistic-statistical approaches for more reliable estimates is emphasised.

Chapter Three presents the results of many years of experiments on industrial sites and sectors. Mathematical models for assessing losses and power balance have been developed using TED. Statistical data has been processed, optimal characteristics have been derived, and a power balance equation has been formulated. The conclusions emphasise the applicability of the developed methodologies in industrial conditions.

The fourth chapter of the thesis is devoted to the development of a methodology for economically efficient operating modes of the power supply systems based on the criterion of minimising losses. The electrical energy efficiency of various types of equipment is analysed, including electrolytic, electric arc, resistance and welding furnaces, compressor and pump stations, ventilation and single-phase consumers. Practical solutions for increasing efficiency are presented, including compensation for reactive loads.

Scientific and applied contributions are presented. New approaches for assessing power losses are derived, statistical methods are applied in a new context, and recommendations for the energy efficiency of industrial installations are formulated.

The practical significance for optimising costs and increasing the reliability of power supply systems is emphasised.

3. Fulfilment of the basic criteria and requirements for the assessment of candidates

for the award of a doctoral degree

With regard to the fulfilment of the general requirements of the regulatory documents for obtaining a doctoral degree, the following can be noted:

3.1 . Doctoral student Desislava Ivanova Delcheva has in-depth theoretical and practical knowledge and experience in the field of scientific specialisation and the topic covered in the dissertation. The doctoral thesis presents in a convincing manner the results obtained from the analytical and experimental studies conducted. This gives reason to assert that the doctoral student has the ability to solve engineering problems and conduct independent scientific research.

3.2 . The bibliography of the dissertation reflects the current state of the scientific issues under consideration and demonstrates the doctoral student's good knowledge of the literature.

3.3 The candidate has written the thesis in concise English language in a logical, well-reasoned and consistent manner.

3.4 The abstract fully and clearly reflects the main points of the dissertation, the relevance of the issues under consideration, the ways to solve them and the results obtained.

3.5 The most significant parts of the dissertation have been discussed and published in scientific journals and conferences (5 in total), which are co-authored.

3.6 . The formulated applied-science and practical contributions are the personal work of the doctoral student and correctly reflect the main achievements in the dissertation.

4. Opinions, recommendations and comments on the dissertation

Spelling mistakes noticed:

- > Incorrectly, in the dissertation, "й" is written instead of "ї", which is a pronoun and is pronounced with stress.

Stylistic errors noted:

The text uses the term "Икономичност" (cheapness, economy). It is more correct to use "икономическа ефективност" (economic efficiency).

The comments and recommendations made do not diminish the scientific and practical value of the dissertation. In my opinion, it represents an in-depth theoretical and experimental study in the field of electricity supply.

5. Conclusion

Doctoral student MSc Eng. Desislava Ivanova Delcheva with her dissertation on the topic: "Improving Energy Efficiency in Power Supply Systems" fully meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations for its implementation and may be admitted to public defence.

I recommend that the honourable members of the Scientific Jury vote **favourably** to award MSc Eng. Desislava Ivanova Delcheva the educational and scientific degree of "Doctor" in the field of higher education 5. "Technical Sciences", professional field 5.2. "Electrical Engineering,

Electronics and Automation" doctoral programme "Elements and Devices of Automation and Computing Technology".

Date: 9.09.2025

Jury:

/Assoc. Prof. ~~Dy~~ Eng. L. Sekulov/