OPINION

on dissertation for the degree of Doctor of Science in the field of higher education 5. "Technical sciences", professional field 5.2. "Electrical engineering, electronics and automation"

Author of the dissertation: **Assoc. Prof. Dr. Eng. Iliyan Hristov Iliev**

Topic of the dissertation: "*Optimization of electricity efficiency in reduced load mode and improvement of the quality and reliability of power supply systems.*"

Prepared by: **Prof. Dr. Eng. Siya Valcheva Lozanova, IR – BAS**

1. Relevance of the dissertation work

The dissertation research is in the field of power supply and electrical equipment of industrial enterprises. It is a well-known fact that the main energy sources generally have a negative impact on the environment. This requires rational use of electricity resources, which includes more effective management of electricity transmission sources. Despite the fact that there is a tendency to use wind generators and solar silicon panels, they are not capable of replacing nuclear power, coal-fired power plants, hydroelectric power plants, etc. The environmental impact of this type of energy is negative, but in the absence of another more effective approach, we should rationally use these basic primary sources. The growing interest in environmental protection and the desire of society for economical and efficient consumption of electricity requires solutions at the local level to overcome these key problems. Information about these processes forms the motivated decisions necessary to preserve and maintain the electricity industry in a healthy environment. The results of the dissertation work allow generating new approaches and methodology for managing electricity efficiency with improved technological parameters. It should also be taken into account that this subject area is key to our national security, which requires a highly professional approach to its problems. In technological terms, this is currently the "most Bulgarian" scientific and applied segment of the industry. That is why the rationalization and optimization of electricity efficiency by minimizing power losses, compensation of reactive loads and improving the quality and reliability of systems is particularly relevant for our country, given the many problems that have recently arisen with its functioning. Therefore, the presented work is relevant, especially for the problems of the national electricity industry.

2. State-of the-art and the main axes of the research

From the dissertation research and the presentation, I conclude that Assoc. Prof. I. Iliev is competent in the current topic. Based on in-depth theoretical

training and practical experience, the research tasks have been thoroughly analyzed and correctly defined, the main ones of which are:

1. To critically examine the literature sources related to the factors influencing electrical energy efficiency (EEEf). To search for a relative relationship between EEEf and some energy characteristics, such as power losses and the quality of electric energy, the problem of φ-factor, compensation of reactive loads, reliability of electricity supply, etc., and these indicators are analyzed in their unity and logical interconnection.

2. To study the legislation in the field of EEEf - regulatory documents, directives, standards at the national and especially at the European level.

3. To analyze classical and modern theoretical models in relation to EEEf. To evaluate the power methods for determining the losses of electric energy in power supply systems, transmission lines and power transformers. To define the energy facilities and to analyze the static characteristics of the load, the power balance equation, the dispersion component of the losses, etc.

4. In a practical and applied plan, to clarify the main statements related to economically expedient operating modes of the energy system, the optimal compensation of reactive loads, the characteristics of the quality of electrical energy and their relative relationship with electromagnetic compatibility, while also studying their influence on EEEf.

5. To study the characteristics of the reliability of power supply and to establish the relationship of this indicator with the EEEf.

6. To conduct experimental studies of various energy processes in power supply systems in the sectoral structures of the country. To determine the power losses, static load characteristics and power balance in the multifactor space.

7. To study the operating modes of multi-transformer substations and to determine the economically feasible operating mode.

From the review of the table prepared by the dissertationist for the minimum requirements for the right to defense, according to the requirements of the Bulgarian Academy of Sciences, it was found that Assoc. Prof. I. Iliev has achieved the indicator results that give him grounds to request the opening of a procedure for defending a dissertation for the award of the scientific degree "Doctor of Sciences". My check established that the name of I. Iliev appears in the List of the NACID.

3. Scientific and applied contributions and results of the dissertation work

I believe that the contributions in the dissertation can be conditionally differentiated as scientific and applied. The author has formulated 2 scientific and 7 applied contributions, which I have summarized as follows:

3.1. Scientific contributions

1. In theoretical aspect, a method has been developed in the multifactor space for determining the models of different output parameters and their optimization. The main goal is to serve as a criterion in defining and formulating the energy category "Electricity efficiency". The proposed approach has been tested by conducting experiments on a large scale and with the location of the country's industry structure. The obtained models make it possible to apply optimization procedures for different characteristics, as a result of which the proposed methodology has a high degree of adequacy, significance, reliability and identity.

2. A scientifically substantiated theoretical model for determining the power balance at a given point in the power supply system is proposed. In this way, the so-called "power balance equation (δP^*)" is defined, which represents a set of combined different energy indicators. The equation allows, by combining the functions of different in nature quantities, to obtain a positive trend in the energy impact. The inequality $\delta P^* < 0$ is formulated, which means that in the considered energy space, as a result of the favorable combination of the various influencing factors, a positive energy effect is obtained and the consumed power is reduced.

3.2. Applied contributions

1. By applying scientifically based approaches, it has been proven that it is appropriate for electrical equipment in power supply systems to operate at voltage levels lower than the nominal ones regulated in the standard. The effect of this procedure is manifested in improving the EEEf, compensation of reactive loads and increasing the reliability of power supply.

2. Models of static load characteristics have been developed for individual branches of industry, which allow for a more precise assessment of conventional power losses from all energy quality indicators. The models are already used in design and research practice.

3. An approach with greater adequacy and precision has been proposed for determining partial power losses, the methodology being built on the basis of the theory of instantaneous active power. The approach has been tested in the study of numerous industrial facilities operating in reduced load mode.

4. A new concept for determining asymmetric and non-sinusoidal modes has been developed, and they are evaluated using power-weighted unbalance and nonlinearity coefficients. The concept adequately reflects the energy impact of the load on the quality of energy and has been successfully tested in a number of industrial facilities.

5. To suppress resonance phenomena in electrical stabilization systems, methods have been developed for their assessment taking into account the impact

of the load, which is a novelty in design practice. The application allows for increasing the reliability and sustainability of the power supply.

6. The correlation between the reliability of the power supply and the mode characteristics of the compensation of reactive loads has been substantiated. Predictive results for reliability indicators in specific industries have been obtained.

4. Assessment of the dissertation candidate's personal participation in the contributions

Based on the presented research and the authorship of the materials in the dissertation, I believe that it is the personal work of Assoc. Prof. Iliev. I do not detect plagiarism, as I am not aware of any third parties having claims to the intellectual property in the dissertation..

5. Opinions, recommendations and notes.

The dissertation is an extensive and well-structured scientific work on the researched issues. The huge volume of more than 400 pages of the work is impressive. It could probably be shortened, but still this is the author's position. There are some repetitions, slips, numerous spelling errors, etc. I recommend that the candidate prepare and send materials on the dissertation work to prestigious Western journals. Also, to summarize and present in an appropriate format the applied results as a tool for the many power engineers in the country. This will be of priority importance for the collegium.

6. Conclusion

The dissertation work of Assoc. Prof. Dr. Eng. Iliyan Hristov Iliev contains research and results through which important scientific and applied tasks have been solved. My overall assessment is positive. There are sufficient contributions that cover the requirements of the ZRASRB, the Regulations for its implementation and the requirements for the development of the academic staff of the IR-BAS for awarding the scientific degree "Doctor of Sciences" (Doctor of Technical Sciences).

Based on the arguments presented above, I propose to the esteemed Scientific Jury to award Assoc. Prof. Dr. Eng. I. Iliev the scientific degree "Doctor of Sciences" in the field of higher education 5. "Technical Sciences", professional field 5.2. "Electrical Engineering, Electronics and Automation".

Sofia, 04.06.2025

Prof. Dr. Siya Lozanova