

REVIEW

about the PhD thesis

Domain of High education: **5. "Technical Sciences"**,

Professional field of study: **5.2 „Electrical engineering, Electronics and Automatics“**

Scientific specialty: **„Automated information processing and management systems“**

PhD student: **Milena Biserova Haralampieva**

Title of the PhD thesis: **INTELLIGENT MANAGEMENT OF THERMAL ENERGY SAVING SYSTEMS**

Member of the jury: Prof. DSc Todor Atanasov Stoilov ,
Institute of information and communication technologies – Bulgarian Academy of Sciences, Sofia, Acad.G.Bontchev str., BL.2

1. Common presentation of the candidate's thesis

The presented thesis contains 126 pages. It is prepared with 4 chapters, contributions together with the publications related to the thesis and references. The list of references contains 61 positions.

2. Actuality of the problems in the PhD thesis

The contribution of this thesis concerns the development of empirical study of technological solutions, which can be used for conversion, storage and use for domestic purposes of predominantly renewable energy sources. The practical tasks solved in this study concern analysis of technological solutions for the usage of solar energy as a source of heat to be used for domestic purposes: home heating and domestic water in the home. The main method of conducting the research is through textual analysis of components of domestic heating systems from solar energy, the principles of heat transfer, and methods of storage of heat. The object of research is not declared explicitly, but it is included in the PhD goals that researches are applied for analyzing potential solutions for the usage of solar energy in thermal heating systems. As a consequence of the provided analysis there are elements of synthesis in the researches.

In the PhD thesis the elements of the synthesis are given in empirical form by assessment of the heating characteristics of the components of a solar system for heat generation for domestic needs. As a result, the PhD thesis claims contributions about the development of intelligent solutions for the design of solar systems for saving solar energy for heating purposes.

My assessment is positive for the research topic in the thesis. I find that the results of the thesis have pragmatically and useful meaning, because they address important and necessary elements in the exploitation of renewable source of heating by storage and usage for domestic purposes.

The importance and actuality of the topical content in the thesis is easy understandable.

The reviewer assesses positively the researches in the PhD thesis. The application part of the thesis has pragmatical and useful values, because they address important and needed elements for solutions on the usage of renewable energy sources for domestic purposes.

I think that the importance of the researches is evident, the results obtained are useful and this proves the positive assessment towards the qualification of the PhD student.

3. Degree of knowledge acquired by the student

The PhD thesis makes profound presentation of the problems and tasks, which take part for the practical exploitation of sources of renewable energy.

In Chapter 1 it is made an analysis about the principles of applications and their potential of usage as renewable energy resources. This analysis has been performed for estimation the possibilities, which can be used for domestic purposes and particularly for heating in home systems. As a consequence of this analysis, the PhD thesis motivates the choice of the problem, which is under consideration for usage of solar power for domestic heating.

The overview in Chapter 1 is easy understandable and it is well presented the potential of environmental and renewable sources of energy, the means for their usage and the power, which these technologies have for domestic usage.

4. Correspondence between the chosen research methodology and the goals and problems targeted in the thesis

The goal of the PhD thesis concerns development of a technological solution for the usage of the solar energy, to store these energy opportunities for the case of heating domestic applications. After the completion of the presented analysis about the features and principles of usage renewable resources, in Chapter 2 it has been made and overview about the existing technological solutions and tools, which use and exploit energy from such sources. The technological tools are not so many in categories: solar collectors, heat exchanger, control systems, home heating system. The peculiarities of these tools are that they have many different technological implementations. They can operate according to different physical principles for heat transfer and / or storage. This fact illustrates the problem, solved in the PhD thesis about the appropriate choice and solutions of many possible technological combinations. It has been illustrated as possible solution to be added an additional source for heating by conventional energy tools. Such inclusion makes changes towards the requirements and the characteristics of the solar system. That is why such solutions are strongly influenced by the particular conditions for exploitation of the heating and or cooling in domestic environments.

In Chapter 3 the PhD thesis provides an empirical design as a working solution about a potential system for domestic heating, which uses mainly solar energy. The PhD research gives advantages to materials for solar heat storage, which have specific phase changing features of their structure for transformation of the solar energy in heating. It has been presented the advantages, which these materials provide for the technological tools and their protection against overheating in solar panels.

Chapter 4 contains the biggest contribution for the PhD research. It presents engineering quantitative calculations for assessment and estimation characteristics and parameters of a heating system, which utilizes the solar energy for domestic purposes. The design of the presented system is made empirically, but the evaluations of parameters and characteristics are calculated according to the assumed technical structure and parameters of the system.

The PhD student demonstrates good acquaintance with the processes of design of domestic heating systems with the usage of solar energy. This knowledge supports the design of operational system for domestic heating, to evaluate the thermal and operational characteristics of the systems and its parameters of the individual technological components.

5. Scientific and practical achievements in the PhD thesis

This thesis contains an analysis about the available principles for usage of renewable energy resources, which can be applied for domestic purposes. This analysis is needed for the estimation of the benefits from the usage of solar energy for domestic heating. The benefits from such researches address recommendations for practical solutions for the design of heating systems in domestic environment. It is made recommendations about the appropriate technological devices, which have to be connected in a common technological system.

I find that this topic has scientific and application character. It has been analyzed the process of design of heating systems for domestic usage, its characteristics and parameters for the case of usage of solar energy as a main energy for heating.

My assessment is positive about the results of these researches of the PhD student. They have useful, formal character and they can be implemented in practice, which proves the pragmatic character of the researches in this thesis.

The practical contribution was proved through declared application interest by a company, proved by a relevant document.

I find that the demonstrated research and application achievements satisfy the legislative requirements for PhD degree. These results give proves that the PhD student can provide by her self researches, to work-out in topical domains for the utilization of renewable energy for practical domestics applications. This plays important role for providing solutions of problems, related with the energy independence in industrial production and life applications.

The reviewer assesses that the content of the thesis gives proves that the results obtained are achieved personally by the student.

6. Assessment with the minimal national legislative requirement for the PhD degree

I find that the presented publications concern the content and topics of the PhD thesis. It has been presented 6 publications. One publication has been presented on international scientific event, which is indexed in SCOPUS reference database. The next publications are presented on scientific events in our country (Automation of Discrete Production, Technical University of Sofia; Robotics, Automation and Mechatronics, Bulgarian Academy of Sciences).

These publications can cover the legislative requirements for awarding the scientific degree PhD It has not been given proves for citations.

The minimal legislative requirement for awarding PhD degree for professional field of study: 5.2 „Electrical engineering, Electronics and Automatics“ requires achieving 30 points for the group of criteria G. The presented documents do not give proves for such evaluations, but my check confirms the needed values with achievement of sub criteria G7 and G8 about publications in indexed and no referred editions or edited books with several authors.

7. Significance of the contributions for the science and practice

The PhD student Milena Haralampieva demonstrates abilities for analysis and assessment of technological systems and tools, which are used in technical solutions for the usage of solar energy for heating of domestic spaces. It is demonstrated profound knowledge of the problems, about the technological peculiarities of the components of building installations where renewable solar energy is used. The PhD student demonstrates abilities for quantitative assessment of the characteristics of the elements of such building systems.

The reviewer assesses that the researches are useful and they give pragmatic results as analysis of the potential and recommendations for the design of appropriate technological solutions for the usage of solar energy for domestic heating.

In the presented documents there is no evidence for indexing and sharing contributions between the authors of the presented publications.

8. Assessments, recommendations, remarks

My assessment is positive for the presented thesis. From the content it is evident that the student has performed by herself studies and researches.

The reviewer does not make remarks for the content part of the PhD thesis. His remarks concern the manner of making scientific researches and about the presentation of the achieved results.

The style of writing of the thesis is mainly descriptive. I recommend the results from the analysis to be presented in table form, to be given comparisons by means to recommend the decision of the author for the choice of appropriate technical device and/or system.

The analysis and the decisions have to be motivated by quantitative proves, assessments and comparisons. By such approach it can be proved and motivated the activities and tasks, needed for implementation different stages of a design of solar heating system. Currently, such approach is demonstrated in relatively small part of the thesis and it is made only in Chapter 4. But this is needed for proving the recommendations, based on research and practical results of study.

The reviewer would like to see given real data from experiments and technical proves. Such data can give real proves for the results and contributions of the researches in the thesis. These remarks are given to the young researcher from an experienced one and they have character of recommendations for her future research activities.

The reviewer finds that the PhD student Milena Haralampieva demonstrates ability and qualification for development by her researches in the domain of analysis and technological developments of practical solutions for the usage of the solar energy for heating in domestic systems.

9. Conclusions

I give positive assessment for the presented research and application results in the PhD thesis of Milena Haralampieva. My estimation is that the legislative requirements of the Law for academic growth in Bulgaria, the Regulations for its application and the internal rules of Institute of information and communication technologies – Bulgarian Academy of Sciences are satisfied. This give me reasons to recommend to the honorable Scientificand Jury **Milena Biserova Haralampieva** to be awarded with the Educational scientific degree “doctor” in the scientific domain: 5. “Technical sciences”, professional field of study: 5.2 „Electrical engineering, Electronics and Automatics“

22.02.2022

Reviewer:

НА ОСНОВАНИЕ

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