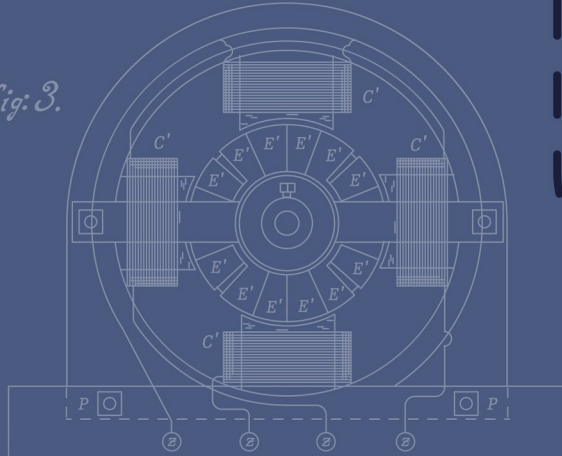




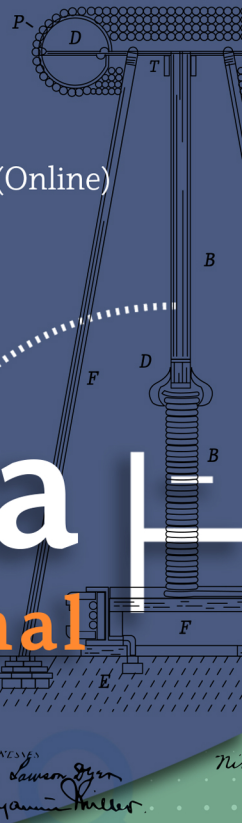
fig. 3.



APPLICATION FILED JAN. 19, 1902 R
1.119.732

ISSN 3009-2892 (Online)

UDC 620.9
621.31



Elektroprivreda

Electric Power Industry Journal

2025

Godina 3, Broj 1
Volume 3, Issue 1





Elektroprivreda

Electric Power Industry Journal



Scientific and professional journal of the joint-stock company "Elektroprivreda Srbije"
in co-publishing with the Nikola Tesla Institute of Electrical Engineering JSC Belgrade



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ISSN 3009-2892 = Elektroprivreda (Online)

EXECUTIVE PUBLISHER

JOINT STOCK COMPANY ELEKTROPRIVREDA SRBIJE BELGRADE

11 000 Belgrade, Balkanska str. 13

Internet presentation: www.eps.rs

Editor-in-Chief phone: +381-11-365-23-63

E-mail: epijournal.editor@eps.rs

The Journal web platform: <https://epijournal.eps.rs>

CO-PUBLISHER

NIKOLA TESLA INSTITUTE OF ELECTRICAL ENGINEERING JSC BELGRADE

11 000 Belgrade, Koste Glavinića str. 8a

Internet presentation: www.ieent.org

Phone: +381-11-39-52-000

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Electric Power Industry Journal - „Elektroprivreda“
is published twice a year, exclusively in electronic form,
at <https://epijournal.eps.rs> as Open Access journal type

COBISS.SR-ID - 121874441

EDITORIAL WORD

Dear readers and collaborators,

You are holding the third regular issue of 'Elektroprivreda' – the *Electric Power Industry Journal*. To keep our content relevant and to further encourage professional and scientific discussions on the future direction of Serbian energy, we begin this issue with an overview of new technologies and their potential. This includes insights into studies on how Serbia can leverage its resources in the journey towards decarbonisation and energy transition. We aim to explore the technical, technological, economic, financial, ecological, and sociological aspects of this critical transformation.

To preserve the highest possible degree of energy independence, we consider the priority use of Serbia's own resources to be crucially important. Therefore, from now until 2050, when the abandonment of fossil fuel-based technologies is required, it is essential to take thoughtful steps to maintain this status – electricity independence – during the 'green' transition and after achieving its goals. To realise this scenario, which we believe is the only justified one, the first necessary step is to realistically, expertly, and impartially evaluate the resources that Serbia has and can rely on as much as possible. This includes the potentials of solar energy, wind, biomass, geothermal energy, and the remaining, so far unused, hydro potential. New hydro systems with weekly and seasonal reservoirs, especially pump storage hydroelectric power plants and pumping facilities, would further encourage the construction of wind farms and solar power plants in Serbia, which are essential for decarbonisation and energy transition. These hydro capacities, with their characteristics and adequate operation, would mitigate the problem of sudden and large variations in energy production, which will increase over time due to the growing share of intermittent sources in the national production portfolio. By optimally engaging new pump storage hydro capacities when it is most advantageous in terms of the electricity market, additional income would be generated, improving the financial performance of the power industry.

The variable production from solar and wind power plants presents a significant strategic challenge for Serbia's electric power system, as nearly 70% of electricity currently comes from thermal power plants using low-calorific lignite. Therefore, it is equally important to collaborate with the scientific community to explore new technologies that could gradually replace these thermal capacities, which currently cover the base load. It is crucial to determine which technologies are realistic, most suitable, and justified under Serbian conditions and circumstances. Additionally, the importance of ensuring the highest possible level of energy independence for the Republic of Serbia must be taken into account.

One paper in this issue is dedicated to the special aspects of using intermittent 'green' sources. The first aspect covers the possibility of using production from renewable energy power plants to offset electricity losses in the system, and the second focuses on control systems for wind generators. Another important topic in this issue is metrology, which is explored through an interesting and useful paper on the inter-laboratory comparison of Inspection Bodies for the verification of electricity meters, owned by the Distribution System Operator.

In closing this editorial, we hope you find the content of this issue interesting, relevant, and useful. We reiterate our invitation for active participation from our readership. If you are intrigued by any of the opinions, ideas, or proposals presented in the following texts, please feel free to submit your discussions, polemics, or personal positions on specific topics to the Editorial Board. We will gladly review them and consider the possibility of their publication in the next issue of the journal.

On behalf of the Editorial Board,



Vladimir Šiljkut (Shiljkut), Ph.D.E.E.
Editor-in-Chief

UDC: 621.311.1:502.131.1(497.11)

Vladimir M. Šiljkut (Šiljkut)¹

Challenges and opportunities for long-term development and decarbonization of the Electric Power Industry of Serbia

¹ Joint Stock Company *Elektroprivreda Srbije*, Belgrade*

Review article

Highlights

- Review of new literature on decarbonization, transition and circular economy
- Proposal of a decarbonized power system model, based on the example of Serbia
- Opportunities and challenges for energy sources diversification and application of new technologies
- Proposal of ways to transfer knowledge in the energy sector of academia into the domain of industry / economy

Abstract

Environmental pollution and resources consumption for the industry operation and development of national economies have made it inevitable to find technical and technological solutions that will enable sustainable future development. Decarbonization, circular economy and diversification of energy sources are therefore imposed as a solution. In the (power) energy sector, they imply energy transition, primarily from the current mass use of fossil fuels to ecologically more acceptable primary energy sources, with an increase in energy efficiency, including an increase in waste heat's and waste materials' usage in the processes of heat and electricity production. Decarbonisation, however, raises complex issues and problems; from technical-technological, economic and financial ones - that long-term process' manners, dynamics and implementation costs, to the issue of its acceptability, fairness and the need to acquire appropriate knowledge and awareness. The example of Serbia, its electric power system (EPS) and "Electric Power Industry of Serbia" (EPIS) shows that it is necessary to establish gradually such a production mix, which would be based and relied on different, environmentally friendly energy sources and on new technology, which will be not only feasible and sustainable in the long term, but also technically, financially and economically optimal for Serbian conditions and opportunities, as well as socially acceptable. That mix must allow the profitable operation of EPIS and be able to ensure the stability and reliability of Serbian EPS operation, security of supply to end-users, the highest possible level of energy independence and security of the Republic of Serbia, and the satisfaction of end-users and EPIS employees. At the same time, the principles that will lead to an increase in energy efficiency, the establishment of a circular economy and the reduction of negative impacts on the environment, as well as on the social aspect should be respected and applied. The selection of the most suitable and appropriate new technologies and particular technical solutions for new capacities for the electricity generation and heat production in the future should be made on the basis of opinions and conclusions reached by experts from scientific and professional circles, through their joint work and synergistic action.

Keywords

**Circular Economy, Decarbonization, Diversification, Energy Efficiency,
Energy Sources, Energy Transition**

Received: February 26th, 2024 Reviewed: March 13th, 2024
 Modified: March 27th, 2024 Accepted: April 18th, 2024
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Note:

The full text of this article is available only in the Serbian language.
 In the English version, only its Abstract (above) is available.

Jadranka M. Janjanin¹, Milan M. Danilovic², Zeljko R. Jovanovic¹

Analysis of Required Monthly Amounts of Electrical Energy Produced from Renewable Energy Sources for Covering Transmission System Losses

¹ EMS JSC Belgrade, Belgrade, Serbia*² Energy Agency of the Republic of Serbia

Professional paper

Highlights

- Variability of average hourly values of technical transmission system losses
- Approximation of power plant production from RES
- Possibility to cover technical transmission system losses from RES

Abstract

The transition to climate neutrality by 2050, the so-called "green" transition is underway and therefore it is important to plan and ensure the sustainability of existing processes. Identification of opportunities and selection of actions are indispensable in planning future work. It often happens that the chosen action does not achieve the desired results, so we have to undergo iterative processes. In order to avoid the application of quick actions and the impossibility of conducting the necessary analyses, it is crucial to observe and design processes in time, especially if they arise from legally defined obligations.

When we talk about the transmission system operator, we recognize the procurement of electrical energy for covering of technical transmission system losses as one of the obligations from the Energy Law. In this paper, we will devote ourselves to a more detailed analysis of the chosen method of procurement of technical transmission system losses from renewable energy sources. The authors of the paper chose wind, sun and waste as sources of electrical energy that they will use in planning the procurement of electrical energy for covering transmission system losses. This paper is a continuation of the analysis that was started in the paper "Renewable Energy Sources as a Resource for the Procurement of Electrical Energy for Covering Transmission System Losses". From the level of looking at the annual needs of electrical energy for covering of transmission system losses produced from renewable energy sources, we go down to the monthly level.

This paper can serve as a guideline for mitigating the overall risks and uncertainties of transmission system operators during procurement of electrical energy for covering technical transmission system losses on the way towards clean energy by 2050. In the paper, we will analyze whether one of the basic principles of the transition, i.e. that the transition to clean energy is objective and inclusive, is justified in the case of transmission system operator.

Keywords

Approximation of production of electrical energy from renewable energy sources,
Climate neutrality, Losses

Notes:

The full text of this article is available only in the Serbian language.
In the English version, only its Abstract (above) is available.

This article thematically follows on from the text *Renewable Energy Sources as a Resource for the Procurement of Electrical Energy for Covering Transmission System Losses*, which was published on November 1, 2024 in the second, Special Edition of "Electric Power Industry Journal", dedicated to selected award-winning papers at the 36th CIGRE Serbia Conference.

Received: December 16th, 2024Reviewed: January 16th, 2025Modified: February 1st, 2025Accepted: February 13th, 2025

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UDC: 621.311.245

Slavica Stojiljković¹, Vladimir M. Šiljkut¹

An Overview of Wind Turbines Control Systems

¹ Joint Stock Company Elektroprivreda Srbije, Belgrade*

Report

Highlights

- Different methods for regulation of wind turbine power
- Ensuring reliable and efficient operation of wind turbines under variable wind speeds
- Wind turbines are inherently nonlinear and time-varying

Abstract

This paper provides an overview of the latest expert literature on wind turbine control systems. Some techniques used in the control of horizontal-axis wind turbines at the individual turbine level are presented and explained in more detail. These controls apply to the blade pitch and generator power. The turbine system is modeled as a flexible structure operating under the presence of turbulent wind disturbances. A review of various turbine operating phases and control strategies aimed at maximizing energy conversion at sub-nominal wind speeds is provided, with a focus on managing aerodynamic loads when the turbine operates at maximum power. After reviewing the basic objectives of turbine control, the paper gives an overview of common linear control approaches and then describes advanced control architectures, addressing why they may provide greater benefits.

Keywords

Linearized wind turbine model, wind generator, wind speed, wind turbine efficiency, wind turbine power regulation

Received: October 22nd, 2024Reviewed: January 18th, 2025Modified: February 10th, 2025Accepted: February 21st, 2025

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Note:

The full text of this article is available only in the Serbian language.
In the English version, only its Abstract (above) is available.



UDC: 006.91:621.317(497.11)

Tatjana Cincar Vujovic^{1*}

Applied metrology in Elektrodistibucija Srbije Ltd.

¹ Elektrodistibucija Srbije Ltd. Belgrade, Serbia

Professional paper

Highlights

- Developed metrology in the economy contributes to the improvement of the quality of products/services and improvement of competitive abilities on the market.
- Interlaboratory comparisons are one of the most important criteria for assessing comparability and ensuring confidence in measurement results.
- The measurement result is complete only if it is accompanied by a quantitative statement about its measurement uncertainty, which is important for obtaining a good measurement quality.

Abstract

Meeting the prescribed requirements for electrical energy meters should ensure a high level of protection against accidental or intentional tampering with the parameters and performance of the meter, with the legally relevant software in the meter, and with the measurement result, and assessing the conformity of electrical energy meters should ensure a high level of confidence.

Interlaboratory comparisons and proficiency tests are a very important aspect of quality control of measurement results and unambiguous confirmation of laboratory competence.

The paper presents the results of interlaboratory comparisons conducted by the Control Body of Elektrodistibucija Srbije Ltd. in the period from 2020 to 2023, with the aim of ensuring trust and reliability of the results of electrical energy measurements in the distribution system.

Keywords

Evaluation of results, interlaboratory comparison, uncertainty of measurement

Received: February 27th, 2024Reviewed: December 30th, 2024Modified: February 12th, 2025Accepted: February 13th, 2025

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The full text of this article is available only in the Serbian language.
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EDITORIAL POLICY AND TOPICS OF THE JOURNAL

When re-starting publishing the Journal “Elektroprivreda”, it has been decided for it to be of scientific and professional nature and to be prepared and published in a new, broader concept and in two languages, in Serbian and English. However, only those manuscripts for which authors from Serbia and region wish so and which are evaluated by reviewers and Editorial Board to have adequate contribution and might be of interest for readers beyond the Serbian speaking area, will be published in English. The Journal is, naturally, open for manuscripts by foreign authors which originals are in English. With the consent of these authors, the approved manuscripts will be translated and published in Serbian, too. Both Cyrillic and Latin versions of published articles are available in Serbian.

The Journal is, typically, published twice a year, and only as an e-version (*on line*). The Journal is an Open Access type, where publishing of the accepted manuscripts is free of charge, without any financial charges to the author. On the other hand, there are no financial liabilities for the Publisher towards the authors, either for submitted or published articles.

The contents of the manuscript submitted for publishing in the Journal has to be an original work of author(s) and it should not be published or publicly presented (either published or presented in a meanwhile, before its first publishing in “Elektroprivreda”), anywhere in the world, or in any form. This rule will not be applied to manuscripts submitted for exceptional, special issues of the Journal that are dedicated to already presented, selected papers from partner conferences, and in this case, such manuscript has to be expanded at least by 30% in comparison to the presented conference paper, improved and additionally reviewed as per the procedure for the manuscripts submitted for regular issues of the Journal.

Only manuscripts having at least two positive reviews by respective experts in the discipline the manuscript refers to, or with majority of positive reviews when more reviewers are engaged, will be published in the Journal.

The Journal accepts manuscripts for consideration and publishes papers of scientific and research nature, particularly manuscripts/papers within the scope of:

- new technologies for providing, processing and exploitation of primary energy resources,
- generation, transmission and distribution of electricity,
- storage and conversion of electricity and heating energy,
- rational consumption of electricity and heating energy,
- development of renewable energy sources,
- information and telecommunication systems,
- organization of power system operations,
- environmental protection,
- rehabilitation of power facilities,
- inventions and innovations,
- restructuring and privatization process in an energy sector,
- electricity markets,
- application of EU legal regulations within the scope of energy; and
- other related disciplines.

The Journal is conceived as a platform and tool for presenting experience, constructive expression and confrontation of views, professional discussion of experts from a profession and practice and from scientific and research institutions and innovation centers. Namely, open exchange of their opinions and experience, regarding strategic development and opting for new technologies may contribute to finding adequate and optimal technical and technological, legal and economic, and organizational and business responses to all challenges coming from decarbonization, digitalization and transition of electric power toward sustainable development.

On behalf of the Editorial Board,

Mr. Vladimir Šiljkut, Ph.D.E.E.
Editor-in-Chief

CLASSIFICATION (RANKING) OF MANUSCRIPTS

When reviewing manuscripts and completing a Reviewer's Report, reviewers propose and Editorial Board - in case manuscripts are accepted for publication - determine their category (rank). Classification (ranking) of manuscripts will be done as per the *Rulebook for classification and ranking of scientific journals* (Official Gazette of Republic of Serbia, No. 159 as of 30 December 2020) and the table provided herein:

Scientific articles:	
Original scientific and research paper	Paper presenting previously unpublished results of own research done by a scientific method
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Professional articles:	
Professional paper	Article offering experience useful in promoting professional practice, but which are not necessarily based on a scientific method
Information article	Editorials, comments, and similar
Report	A book report, computer program report, case report, scientific event report, and similar
Expert critique, i.e., discussions and reviews	Discussion of a certain professional topic

First A. Author¹, Second B. Author², Third C. Author³, ...



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- Key aspects and messages of the work should be presented in a maximum of four short items/bullets
- The sentences of these items must be short, concise, auxiliary verbs can be omitted
- E.g.: The structure and design of work for publication are considered by the instruction

Abstract

The Abstract of the article should contain a concise description of the problem, applied methods and conclusions. It is an essential part of the article and should be clear and concise. The Abstract should be informative, giving an overview of the issues, the procedure and the main conclusions, results, and their significance. Do not write in the first person, do not list references and equations, and avoid abbreviations. It should not contain more than 300 words (in Serbian) to 350 (in English, including definite and indefinite articles before nouns).

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1. INTRODUCTION

The *Elektroprivreda* journal publishes categorized articles: original scientific papers, previous announcements, reviews and technical papers in the field of electrical engineering and energy.

All papers are subject to review. The authors are solely responsible for the originality of the paper, the quality and reliability of the results. By submitting the paper, the authors accept all the rules specified in these Instructions.

This document contains paper preparation instructions. Authors are requested to fully comply with these Instructions when preparing their paper to avoid any problems when printing the paper.

The document is a sample for *Microsoft Word* (version 7 and higher) and is also an example of the desired paper formatting. It contains all the necessary information about the paper format, font type and size, as well as the rules explaining the procedures related to equations, units of measurement, figures, tables and other parts of the paper.

The complete paper containing the manuscript, tables, diagrams, drawings, photographs and full names and surnames of authors with affiliations should be submitted by uploading it to the Manuscript Handling Application, available on the Journal's website, <https://epijournal.eps.rs/prijava> or, alternatively, by sending it to the following e-mail: epijournal.editor@eps.rs.

The paper should not be more than ten pages long (without the list of references and the title, key messages, short content and keywords in English), except in the case of review papers and special editions of the Journal with extended award-winning papers from conferences, in which case the number of pages is not limited, nonetheless it is recommended that it should not be more than 16 pages long.

The original paper should be presented in A4 format (210x297) mm. The text of the paper should be justified. All margins should be set to 2 cm. The text of the paper should be single-spaced. The paper can be written in Serbian or English. (The editorial board decides which paper will be translated into another language, in order to make them available to as many readers as possible.) The font size for individual parts of the text is as in these Instructions. Complete mathematical derivations should be avoided in the paper. The necessary derivation may be given, if necessary, as a whole, in the form of one or more attachments.

This document can be downloaded directly from the following web address <https://epijournal.eps.rs> and used as the basis to prepare the manuscript, simply by entering parts of the paper text in certain places in this document.

It is recommended that the paper text begins with an introduction where the problem and task of the paper are formulated. An overview and commentary of the used literature from the specified area should be given and the position and contribution of the paper in relation to the specified literature should be indicated.

2. CHAPTER TITLE (for example: TEXT PREPARATION)

For greater clarity, the text of the paper should be divided into chapters and subchapters. Chapters and subchapters should be numbered with Arabic numerals, subchapters with numbers separated by a period. Please separate the titles of chapters and subchapters from the text before and after the title with one blank line. Line breaks in the text title or subtitle should be avoided.

2.1 Subchapter levels

With subchapters, it is not desirable to go lower than the second level, for example 2.1, 3.3, etc.

2.1.1 Third subchapter level. It is allowed only exceptionally, if this contributes to the methodological and general clarity of the paper text and if written, similar to the subchapter titles, in bold lowercase letters, but ending with a period, after which, in continuation of such line and written in normal font, the first sentence of this subchapter begins.

2.2 Positioning of tables and diagrams

Tables, figures and diagrams may, if necessary, be in one or both columns. All figures and tables should be placed in the text close to, but not in front of, the place in the text where they are first mentioned. Figures and tables in the appendices should be marked in the same way as in the text of the paper.

2.3 First page

In the middle of the first page, the paper title is indicated in bold letters, size 16, *Times New Roman* type. Below the title, the full names and surnames of the authors are listed in size 11 letters. The author's affiliations are listed below the names and surnames, in size 10 letters. After specifying the authors' data, the first page lists the key messages of the paper, a summary of the paper and keywords, in size 11 letters.

If the paper is written and approved for publication only in the Serbian language, after the content described in the previous paragraph, the title of the paper, key messages, summary of the paper and key words in English are listed in the final version of the paper for publication.

If the work was written in English and approved for publication, it will be fully translated and published in Serbian, with identical formatting.

If the paper was written in Serbian and approved for publication in both languages, it will be fully translated and published in English, with identical formatting.

In the lower left corner of the first page, the full information needed to contact the first author of the paper should be specified.

All this is easily realized by using the provided first page template by simply entering the anticipated text in places provided under the Instructions.

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Equations should be placed in the middle of the text and numbered with Arabic numerals in small (round) brackets along the right margin of the text. Mathematical software (*Microsoft Equation Editor for MS Word* or *MathType*) should be used for equations. E.g:

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2.6 Tables

Tables should be inserted in the text where they are first mentioned or immediately after. They should be marked with Roman numerals, and the number and name of the table should be placed above the table. E.g:

Table I Duration of simulations and memory usage

ISCAS circuit	CPU time [s]	Memory usage [MB]
c17	2	3.9
c432	62	68.7
c880	160	152.6
c1355	283	178.8

2.7 Figures

Figures should be carefully prepared and inserted into the text in the designated place. The figure number and name must be below the image. Figure number should be marked with Arabic numerals. For the sake of better understanding, please avoid excessive information in the figures. All comments related to figures should be in the header. Typescripts should be chosen carefully to ensure clarity. Please attempt to describe the figure axes with words, not just symbols. For example, it is better to specify the **time** t , rather than just t . Symbols for units of measurement should be placed in parentheses.

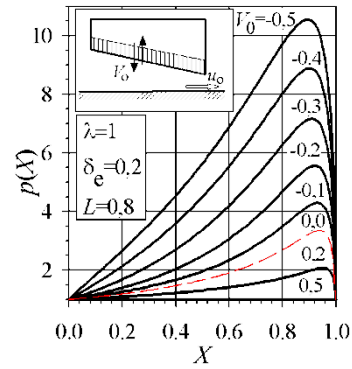


Figure 1. Figure description

3. CONCLUSION

Although the conclusion should contain an overview of the key results of the paper, it should not repeat the part stated in the Summary. The conclusion may explain the importance of the paper or suggest possible applications of the achieved results and provide guidelines for further research on the issues covered by the paper.

ACKNOWLEDGMENTS

Acknowledgments for sponsorship, funding or assistance, if any, should be given as a separate, unnumbered section before the list of references. Please use the singular in the title even when there are several acknowledgements.

REFERENCES

The list of references should be provided at the end of the paper in a separate, unnumbered section. References should be numbered with Arabic numerals in square brackets, according to the order of citation in the text of the paper. When citing, please make sure that the references are accurate and complete, ie. they should fully describe the data sources.

All mentioned references must be directly cited in the text of the paper by stating the reference number in square bracket. Please do not limit yourself to listing your references, but also list relevant references from the field under consideration.

Below are examples of how to cite references: a paper published in a journal [1], a book [2], a chapter in a multi-authored book [3], a paper published in a conference proceedings [4] and an article taken from a website [5].

- [1] Šiljak D. D, Stipanović D. M, "Robust Stabilization of Nonlinear Systems - the LMI Approach", *Mathematical Problems in Engineering*, Vol. 6, No. 5, pp. 461-493, 2000.
- [2] Marković Z., "Granična stanja čeličnih konstrukcija prema evrokodu", *Akademski misao*, Beograd, 2014.
- [3] Deavours D., "UHF RFID Antennas", in: Bolić M. (Ed.), *RFID Systems - Research Trends and Challenges*, Ch. 3, Wiley, New York, 2010.
- [4] Oćokoljić G., Živković S., Subotić S., "Aerodynamic Coefficients Determinations for the ATM Model with

Lateral Jets Simulation - Experimental and Numerical Methods", Proc. 4th International scientific conference on defensive technologies OTEH 2011, Belgrade, Serbia, pp. 17-22, 6-7 October 2011.

- [5] Vukić B., "Društvene igre za visokopozicionirane poslovne ljude" [Internet]. Beograd; Novi Sad: Adizes Southeast Europe; 2010 [citirano 19.03.2012]. Dostupno na: <http://www.asee.rs/?page=142&oi=69>

APPENDIX (ATTACHMENT) 1

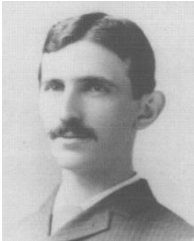
Appendices, if necessary, should be listed after the References. If there are more, they should be numbered with Arabic numerals. In case the attachments contain

Table A.I Name of the first table of the appendix

Heading	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Row 1							
Row 2							
Row 3							
Row 4							
Row 5							
Row 6							

BIOGRAPHIES

A short biography should be provided for each author. Please start with the author's first and last name and give his/her short, mostly professional biography. A photo of the author should also be included. A sample biography is provided below.



Nikola Tesla was born in Smiljan in the Austrian Empire on 9 July 1856. He graduated from the Austrian Polytechnic School in Graz and studied at the University of Prague. His work experience included American Telephone Company, Budapest, Edison Machine Works, Westinghouse Electric Company and Nikola Tesla Laboratories. His particular fields of interest were high frequency fields. Tesla received honorary degrees from institutions of higher learning

tables or figures, they should be numbered with the letter "A" followed by a period and a serial number (namely: for tables in Roman, from "I" onwards, in a uniform order for all attachments; and for figures in Arabic, from "1" onwards, uniform for all attachments).

APPENDIX (ATTACHMENT) 2

Depending on their content, attachments can be formatted as double-column or single-column. In the case when this allows better visibility for the reader, figures and tables in attachments can be rotated to the left by 90°.

including Columbia University, Yale University, University of Belgrade and University of Zagreb. He received the Elliott Cresson Medal from the Franklin Institute and the Edison Medal from the IEEE. In 1956, the term "tesla" (T) was adopted as the unit of magnetic flux density in the MKS system of units. In 1975, the Power Engineering Society established the Nikola Tesla Award in his honor. Tesla died on 7 January 1943.

Authors shall submit a signed Declaration of Authorship and Originality of the Manuscript to the Editorial Board of the Journal when submitting the paper; the form may be downloaded from the Journal's website,

<https://epijournal.eps.rs>.

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