R E V I E W

regarding competition for academic position „Associate professor“, in professional field 5.4 Energy for subject „Electric power plants and substations“, in department “Electric Power Engineering” in Faculty of Electrical Engineering in Technical University - Varna, announced in DV issue 105/18.12.2018. with candidate eng. Nikolay Deyanov Nikolaev, chief assistant professor PhD

Reviewer: eng. Dimitar Iv. Dimitrov, DSc, professor in TU-Varna, retired

1. General grounds and biographic data

Eng. Nikolay D. Nikolaev is born on 13.06.1986 in the city of Shumen. IN the period 2005-2009 he has been a bachelor degree undergraduate student in major “Electric power engineering and electrical equipment“, profile „Electric power engineering“ in TU-Varna, in 2009-2011 he has been a student in master degree course on “Electric Power Engineering”. As a student Nikolay has earned 1st place in the republican Olympiad on Theory of Electrical circuits in Plovdiv 2008. For the accomplishment of excellent results he has been awarded a certificate from the Electrical engineering faculty; award “Student of the year of Bulgaria for 2008” as well as award “Student of the year for category Engineering sciences” awarded by Ministry of education of the National student’s council. In the period 2011-2014 he has been a PhD student in major 02.06.06 “Electric power grids and systems“. In 2016 he has earned a PhD degree for dissertation „Modelling of the impact of renewable generation on the operation of electric power systems“.

In the period 2008-2011 the work experience of the candidate comprises the following positions: „ELIA AD“-Dobrich, design and production of distribution panels, transformer stations, switchgears etc.; „INSTALSTROY OOD“-Shumen construction of heat, ventilation and conditioning systems; “DIM-93 OOD“- design and production of distribution panels, transformer stations, switchgears, LV MV and HV power lines; „HELPIK OOD„-Sofia design in the field of hydro-energy systems, electrical part of hydro power plants, hydraulic and governing systems etc.

From 2011 to 2013 eng. N. Nikolaev is a part-time assistant prof. in department “Electric Power Engineering” in TU-Varna, from 10.2013 to 07.2016 a full-time assist. Prof., and from 07.2016 to the present moment occupies a position of a chief assist. Prof. in the same department.

2. General description of the presented material

The candidate presents himself to this competition with a defended PhD thesis and 23 scientific papers. The categorization of the latter is the following: in Bulgaria 13 abroad - 10 items. All of the published in international conference proceedings. The papers equivalent to monography are 10: 7 of the published abroad and 3 in Bulgaria. The indexed publications are 14 and the other 9 are non-indexed.

I accept all publications for review.

The following documents are also provided:

* Doc.№8.1: Scientific contributions of the candidate regarding the competition;
* Doc.№8.4: List of the authored teaching material: *Lecture notes and other guides – 5 items. *Development of education software – 2 items; * Developed courses with candidate's own materials – 5 items.
* Doc.№ 8.5: List of national scientific projects - 2 prj.
* Doc.№8.6: List of projects at HTP-TUV EOOD - 4 prj.
* Doc.№ 8.7: List of participation in projects funded by the State with respect to Naredba 9 of the Ministry of education – 6 prj.

The scientific metrics of the presented materials are:

Category A. Defended PhD thesis -50 pts.

Category B4. Scientific papers – equal to monography – that are indexed in world renown databases – 7 items with 4 authors and 3 items with 3 authors: totally 165 pts. out of minimum 100 pts. for cat. B.

Category Г7. Papers non-indexed by world-renown databases – totally 160 pts. - all 4 items have single author. **Category Г8.** Science papers in non-indexed journals and proceedings - total points for the candidate 60 pts.: 9 papers with 3 authors. Totally Г7+Г8 requires 200 pts, the candidate has 220 pts.

The statements above indicate that the minimal national requirement are fully met.

3. General characteristics of the scientific and applied scientific activities of the candidate

The overall scientific activity of the applicant is in the field of the competition and is aimed at the study of specific problems and characteristics of the electricity sector. It covers the fields of * power stations and substations; * smart grids; * studies of established regimes, transition processes and stability of the EES.

The results of the works express the strong and undisputed opinion that the candidate has high qualification and experience, has excellent knowledge and skills in the field of specialty, RES and a number of software products. All this sets a ground for a successful scientific research.

4. Assessment of pedagogical training and activity of the applicant

The pedagogical training of the candidate is at a very high level. He teaches bachelor degree course on: "Electric part of electric power plants and substations"; "

Electric part of electric power plants ”; “Engineering practice – part 3”; “Technologies for power generation”; „Power system operation and control”; master degree courses on: „Organization and operation of electric power assets”, “Design of electric power assets”, “Power production from renewable energy sources”.

On the basis of the documents provided by the applicant, item 8.3 for the individual workload, the Ж22 can be estimated with 166 points out of minimum 30 pts.

The applicant has developed software with learning objectives for majors “EE” and “EES”:

* “Computer aided studies of electric power systems” for bachelor degree: two software products from computation and analysis of power flows.;
* “ Organization and operation of electric power assets” for master’s degree: software simulators for all types of MV/HV substation switchgears.

Chief assist. Prof. PhD eng. Nikolay Nikolaev has strong personal contribution for the modernization of the department’s lab facilities., (“8.2.Spravka MTB”), with the following:

1. Lab 710E „Power plants and substations“ – overall rehabilitation and renovation of the electrical panels. A number of complex lab boards are modernized: programmable electric load, SCADA system and others.
2. Lab 711E „Modern electric power systems“.
3. Lab 709E „Electric grids and systems“-participation in the modernization of the computer facilities.

The candidate has supervised 7 bachelor degree theses and 20 master degree theses, and has reviewed 4 bachelor degree theses and 21 master degree theses.

This shows that the teaching activity of Ch. Assoc. Prof. Nikolay D. Nikolaev is diverse, active and very successful.

5. Key scientific and applied scientific contributions

A collection of publications equivalent to monographic work is presented and united under the title "**Operation of EPS in the Conditions of increasing RES share and technologies for intelligent control**". It covers the following topics:

1. Identification of the consumption patterns and their management in the current EPS. 2. Electro-mechanical transient processes and stability with increasing share of RES generators. 3. Electromagnetic transient processes in modern EPS. 4. Implementation of a physical model of the EPS regimes with a share of RES generation.

The contributions are as follows:

Demonstration of new means of significant new aspects of existing scientific fields

*A probabilistic approach based on the Monte Carlo method was developed in solving the stability and uncertainties in the mathematical model of the EPS. The proposed algorithm is applicable to multi-machine EPS and identifies critical operating modes [B.4-2].

* Mathematical models and a computer program for the analysis of electro-magnetic transients were developed, in which the formulated system with homogeneous ODEs is discrete and solved with time-invariant methods; *the mathematical model is implemented in open-source programs [B.4-7], which enriches the model and algorithmic base. Waveforms models were developed for direct lightning strikes at the EPS facilities. New precise results were obtained for the atmospheric overvoltage amplitudes and the energy load to evaluate the effectiveness of the surge protection [B.4-5, B.4-6].

Creating new classifications, methods, constructions, technologies

*Models for different components of smart grids have been developed: power storage depots, renewable energy generators, electric vehicles and manageable loads. The task of balancing the distribution networks has been developed [B.4 -3].

* introducing into the learning process new open source software products that are not currently available on the market and launch of implementation of object-oriented programming in the development of software for calculating regimes and management in the EPS [B.4-7].

* A technical project for a research laboratory on the impact of RES-based plants on transient processes and stability of EPS [B.4-9].

* An innovative concept has been developed and a physical model, simulating PV modules, which is compact and of high power (≥3 kW), has been developed, unlike the commercially available bulky physical simulators, real PV modules and lighting systems with limited power (<1 kW) [B.4-10].

Formulating or justifying a new theory or hypothesis

* To identify the energy consumption of each electric appliance, a sustained algorithm for indirect identification of passive appliances has been developed [B.4-1,B4-4].

* A hypothesis has been formulated and proven that RES generators can participate in regulating the frequency and active power in EPS: structural models and algorithm for optimization of the parameters of their regulators is developed [B.4-8].

The PhD thesis published by the candidate on "Modeling the influence of RES generators on the EPS operation" has the following contributions:

* Development of a mathematical model of EPS with RES for the calculation of el. mechanical and electromagnetic transient processes.

* Applying a fuzzy-logic power flow algorithm to assess the impact of RES generators.

* Creating a probabilistic power flow algorithm using the Monte Carlo method to study the impact of RES generators.

* Creation of a computer program that implements developed mathematical models for calculating determined and stochastic power flows, electromechanical and electromagnetic transients.

* A systematic study of the impact of WPP and PVPP on the levels of short and earth

connections in the electricity grids.
*Structural models have been developed to study the impact of RES plants on EPS frequency regulation and algorithm to optimize the parameters of their power regulators.

Contributions in the submitted works of the applicant, other than those form the monographic work, are scientific and applied and cover evidence, new constructions, methods and technologies, obtaining confirmatory facts. The main ones are related to:

5.1 Demonstrating with new resources to new and emerging scientific areas and problems

* Two algorithms have been developed to determine the stability boundaries and the shortest path to its reaching on the basis of the Monte Carlo method and on the basis of singular value decomposition [Г.7-1, Г.7-2]. This overcomes the disadvantage of existing stability calculation algorithms which, when solving optimization tasks, report only one way in which instability could occur, relying on pre-defined system load conditions for determining the distance to the point of instability.
* New data on PSS3B's capabilities to provide adequate phase compensation for a wide range of frequencies [Г.7-4]. The study shows that the PSS3B achieves a phase compensation comparable to that of PSS2B, for which its structural circuitry needs to be supplemented with a reflector and/or low pass filter to avoid the increase of torsional fluctuations.
* New facts have been obtained and confirmed by other calculations, in terms of the savings achieved under different balancing energy sources [Г.8-9]. The main aspects of the successful implementation of SMS - social, regulatory and technical are analyzed, and summary conclusions [Г.8-8]. The new facts obtained relate to the real economic efficiency of the different balancing items and the impact of their volume on the economy of the balancing groups.
*Evidence has been made that the trend towards introducing an increasing number of automatic controllers in the future will require specialized methodologies to coordinate their proper operation in order to reliably ensure the stability of the EPS [Г.8-6].

5.2. Obtaining confirmation facts

* Evidence has been made, based on multivariate calculations and synergy with other algorithms, that the algorithm with singular decomposition algorithm is able to indicate the path to the closest point of instability [Г.7-3].
*Obtaining confirmation facts indicating that the developed algorithm for indirect identification of household electrical appliances identifies the origin of the consumed electricity and this identification covers a substantial part (about 80%) of the consumed electricity [Г.8-3].

* Receiving confirmatory facts about the benefits of the use of multi-channel system stabilizers (PSS4B) in large electric energy combinations to damp inter-area and local el. mechanical oscillations [Г.8-1].

5.3. Creating new technologies, schemes and methods

* Problems have been found in applying the Newton algorithm of the second order related to its convergence to irrelevant solutions, and improvements have been developed and proposed [Г.7-3].
* A new algorithm for initialization of the DFIG parameters is developed, which takes into account the losses in the generator and the filters: the resulting solution is highly accurate, there are no unwanted transients [Г.8-4].

5.4. Applied science activities

* An algorithm for linearization of the EPS mathematical model and stability analysis for small-signals, tuning of power system stabilizers with phase compensation method are implemented. The implementation is in the form of specialized software for use in General Electric Corporation (Appendix 8.6 "List of topics to HTP-TUV Ltd.").
* An electronic system for control, signaling and measurement (SCADA), designed and built in Lab.710E "Power stations and substations" [Г.8-7].
* An original experimental complex and a virtual environment of the collected data from a user survey were created, which can create typical or random load profiles of the devices in a simulated virtual home. This output is used as a tool to develop and verify a device recognition algorithm [Г.8-2].
* To eliminate the lack of software to calculate short-circuit currents with RES generators has been developed an algorithm for presentation of WGs and PVs by model of SG. With calculations, it is shown that the synchronous machine can be successfully used to represent RES power plants when calculating the s.c.c. [Г.8-5].

5.5. Teaching materials

The candidate has developed the following study materials for Bachelor's degree courses:

1. Lecture notes on " Electric part of electric power plants and substations ", TU-Varna 2014. – book with 110 pages with co-authors, as the candidate authored significant part of it.
2. Guide for project design on „Electric part of electric power plants and substations" , 42 pages and 17 drawings.
3. "Technologies for power production" – book in process of publishing, 119 pages.
4."Design of electric power facilities", part of a lecture notes, 30 pages.
5. „Electric Power Engineering", part of lecture notes, 61 pages.

Book №3 is in a publishing process, while №2, 4 and 5 are not published but are uploaded for free usage on the department's web site.

Developed teaching materials are fully in line with curricula and are methodologically properly organized.

6. Significance of the contributions to the science and practice

The significance of the contributions to the science and practice is high and indisputable. It is expressed in the successfully developed and obtained scientific and technical results of national scientific projects and projects at VTP-TUV EOOD, and projects financed by the state budget and requirements of Ordinance No. 9 of the Ministry of Education and Science (lists 8.5, 8.6, 8.7).

For the results, the candidate received awards: Zlatan Bratchkov Award for Young Scientist of the City of Varna in the "Technical Sciences" category for 2014. Diploma for contribution to scientific research in 2008, awarded by the mayor of Varna.

It is a very good impression that the problems of the doctoral dissertation developed are lasting, and they continue to solve the problems identified in the publications and a number of scientific research projects.

The new developments that continue the dissertation are:

* The probabilistic models are extended with the capability to investigate the small-signal stability.
* An algorithm for tuning of RES generators has been developed to optimize their participation in the process of frequency control of large disturbances.
* A laboratory complex has been developed to physically test hypotheses defined in the dissertation.
* A methodology has been developed for simulating RES generators using synchronous machines for the purpose of calculating short-circuit currents.

With the active participation of the applicant, implementation of software for tuning power system stabilizers in one of the largest global concerns "General Electric" has been done. The results are highly appreciated, a good attestation of which is a recently signed contract with the Siemens concern for the development and deployment of a similar software product under the supervision of PhD Eng. Nikolaev.

The resulting scientific and applied results are of interest to the research community, which is why they are cited.

Category Д. subcat. Д.1.- citations or reviews in indexed scientific databases:

* paper [A1] of the candidate is cited in 3 publications, [A2]- cited in 1 publ.;
* Reviews by the candidate on 2 publications.

Total points for citations and reviews for the candidate 60 out of minimum 50 pts.

Contributions in the applicant's scientific papers are significant for the department and TU-Varna. Through them, knowledge and approaches to research are extended. They apply to the training of students and the construction of the material base.

7. Critical remarks and recommendations

I have no critical remarks on the materials submitted. However, I consider:

In [B 4-9], the concept of modeling is required to be formed after presenting the purpose of their characteristics, taking into account inverting, recuperation, filtering, SCADA control, etc.

In [B 4-1], it is necessary to indicate the identification of household users in particular cases: users with ECM applied; users of a different nature but having the same PV mode and the same energy consumption.

For [B 4-10], editing adjustments are required. It is necessary to define the parameters of the simulator-fig.2 for V-A characteristic of real PV.

Let me make the following recommendations:

* to publish the monograph presented as a set of articles;
* the innovations in the development to be protected by patents or utility models;
* the results of the surveys to form deployment methods and the users to evaluate the implementation by economic indicators.

8. Personal impressions and opinion of the reviewer

I have the impression that the candidate has a high level of professional training, in-depth knowledge and is precise in the execution of the scientific projects. Chief Assist. Prof. Nikolaev, with his diverse activities, contributes to the establishment of the specialty as a modern and modern one, and the occupation of the academic position "associate professor" of him is fully deserved and worthy.

COUNCLUSION

According to the submitted documents and the analysis of the work done, I believe, in personal conviction, that Ch. Assist. Prof. Nikolay Deyanov Nikolaev has an active pedagogical and scientific research activity and his works have sufficient scientific, scientific and applied contributions. They meet the legal requirements of the for the occupation of an academic position "associate professor", which gives me the opportunity to propose to Ch. Assist. Prof. Nikolay Deyanov Nikolaev to take the academic position of "associate professor" in the professional field 5.4. under the specialty "Electric Power Plants and Substations" at the Department of “Electrical Power Engineering” of the Faculty of Electrical Engineering at TU-Varna.

Varna, 25.03.2019

Reviewer:
/ Prof. DSc eng. D. Iv. Dimitrov/

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