International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

December 2016	Issue 29	Volume 8	Number 4	Pages 1-7

PROBABILISTIC ESTIMATION OF VOLTAGE STABILITY LIMITS IN A POWER SYSTEM WITH INTEGRATED DISTRIBUTION GENERATION

N.R. Rahmanov [1] **J. Bilbao** [2] **N.M. Tabatabaei** [3,4] **O.Z. Kerimov** [1] **R.N. Rahmanov** [5]

1. Azerbaijan Research Institute of Energetics and Energy Design, Azerenerji JSC, Baku, Azerbaijan
okerimov@yahoo.com, nariman@cpee.az
2. Applied Mathematics Department, University of the Basque Country, UPV/EHU, Alda. Urkijo, Bilbao, Spain
javier.bilbao@ehu.es
3. Electrical Engineering Department, Seraj Higher Education Institute, Tabriz, Iran, n.m.tabatabaei@gmail.com
4. Management Department, Taba Elm International Institute, Tabriz, Iran
5. Azeri Project, British Petroleum (GPO, UK), Baku, Azerbaijan, rahmar@bp.com

Abstract- In modern power systems the application of distributed generation with hybrid-conventional and renewable sources of power is taking place. Besides, it is planned that in nearest future the share of renewable power would be increased at the expense of wind and solar energy sources. Considering intermittent and casual character of power production by wind and solar PV units the probabilistic estimation of power system condition and development of new approaches to control system operation during stochastic changes becomes very urgent. Grow of power production from wind and solar PV plants would increase the share of stochastic processes at the power system and primarily would cause the probabilistic changes of voltage profile, its marginal values, which determine system stability. At this paper the authors made the estimation of voltage marginal values at the network with distribution generation with various shares of wind turbines being in operation and the number of which defined by casual process of power generation. Static voltage stability for every wind power generation value was determined by loading Margin Method. Modeling of probabilistic regimes of power system with different number of working wind generators, system operation analysis on various stages of loading till voltage stability limit was conducted on the network of distributed generation integrated in Azerbaijan Energy System. Probabilistic characteristics of voltage marginal values at the PCC (point of common connection to the main grid) as a function of total wind energy are presented. Estimation of maximum available, considering provision of voltage static stability, total wind power connected to the studied network with distributed generation is done.

Keywords: Voltage Stability, Voltage Stability Limit, Distribution of Voltage Profile Probability, Probabilistic Load Flow, Sequences Loading, Distributed Generation, Wind Sources.

I. INTRODUCTION

At the last 10-15 years, power production from renewable sources due to application of wind turbines and PV solar units grew substantially. As far as renewable generation grew every power company has needed to make appropriated changes in existing Grid Codes [1, 2].

Research made in Power Systems with considerable amount of connected wind energy reveal that with deep penetration of renewable power voltage variations in the network becomes more noticeable and exceed marginal limits [3, 4, 5].

At many practical cases of steady state operation of wind plant the probabilistic assessment of maximum value for voltage variation is an important factor defining voltage stability. According to IEC 61400-21 CDV [6] it is recommended to use probabilistic load flow analysis to provide that connected to main grid wind turbines (WT) resulted in voltage values which would exceed stability limits at the cases then systems load and wind power production have maximum values.

Impact on voltage static stability of wind turbines equipped with induction DFIG machines studied at [7-10]. During strong wind gusts electromagnetic moment of wind turbine with induction generator has a big variability resulting in variability of produced active power. The consumption of machines reactive power is raised. And this may be a cause of voltage collapse. At these circumstances to provide a stable operation of WT it is necessary to apply reactive power compensation means [11-15].

Control abilities of inverter from DFIG machine to improve voltage stability i.e. to expand stability margins studied at [16-19]. At this paper the probabilistic modeling and operation analysis of system with distributed generation having different share of acting wind turbines is offered. Wind turbine model is introduced as a casual power generation process, determined from wind speed measurement data.

Static voltage stability limit is determined by multiple repeated probabilistic load flow calculation carried out for preset sample of casual process of power generation and load values from nominal to maximum. The probabilistic marginal voltage characteristics at PCC as a function of total produced wind power as well as estimation of maximum available total wind power connected to the main system, considering a provision of voltage static stability are presented.

II. MODELING OF CRITICAL VOLTAGE REGIME AT THE SYSTEM WITH DISTRIBUTED WIND PLANTS

A. Random Sample Modeling of Wind Plant Generation

With growth of wind power share at the system there is a necessity of voltage stability improvement occur and this problem can be solved by efficient control of reactive power and voltage. Considering indefinite and intermittent character of power generation from wind plants connected to the grid, parameters defining system stability as margins of transmitted power, critical values of nodal voltages would have random character of changeability.

To determine values of these parameters taking in account a stochastic character of regime it is necessary to apply a probability model. There are a different digital and analog methods of analysis for probabilistic load flow calculation at energy system caused by stochastic character of load or generation [8, 13, 20]. The suggested digital methods of probabilistic load flow solution leads to iterative calculation of steady state operation for various random values of total wind power generation connected to a Grid [21-24].

A sample of random values of power generated by wind sources is formed by evaluation considering wind speed measurement and wind turbines data in accordance with expression [4]:

$$P_{WT}(\upsilon) = 0.5\rho A C_{\rho}(\lambda,\beta)\upsilon^3 \quad (1)$$

where, ρ is air density, A is blade swept area (m^2), $C_{\rho}(\lambda,\beta)$ is power factor (don't mix with cosφ), υ is wind speed (m/s), and β is blade turn (pitch) angle. Generated wind power as a function of wind turbine speed may be presented as:

$$P_{WT} = \begin{cases} 0 & \text{if} \quad \upsilon < \upsilon_{CI} \text{ and } \upsilon > \upsilon_{CO} \\ P_m \dfrac{\upsilon - \upsilon_{CI}}{\upsilon_H - \upsilon_{CI}} & \text{if} \quad \upsilon_{CI} < \upsilon \le \upsilon_r \\ P_m & \text{if} \quad \upsilon_r < \upsilon \le \upsilon_{CO} \end{cases} \quad (2)$$

where, P_m is wind units nominal power, $\upsilon_{CI}, \upsilon_{CO}$ and υ_H turn on, turn off and nominal speed.

For wind turbine equipped with induction machine production of active power and reactive power consumption may be determined from:

$$P_W = \frac{-Sr_2}{r_2^2 + S^2 X^2} u^2 \ge 0 \quad (3)$$

$$Q_W = \frac{SX}{r^2 + S^2 X^2} u^2 \le 0 \quad \text{or} \quad Q_W = \frac{SX}{r_2} P_W \quad (4)$$

Ignoring power losses, production of active power in Equation (3) may be expressed as:

$$P_W = \frac{-Sr_2}{r_2^2 + S^2 X^2} u^2 = \begin{cases} 0 & \text{if} \quad \upsilon \le \upsilon_{CI}, \upsilon > \upsilon_{CO} \\ P_m \dfrac{\upsilon - \upsilon_{CI}}{\upsilon - \upsilon_{CI}} & \text{if} \quad \upsilon_{CI} < \upsilon \le \upsilon_r \\ P_m & \text{if} \quad \upsilon_r < \upsilon \le \upsilon_{CO} \end{cases} \quad (5)$$

It becomes evident that random variation of active and reactive power of wind units induction generator reflected a stochastic character of volatility dependable from stochastic wind speed υ through the slip function of υ.

B. Stochastic Character of Wind Power Generation in Modeling Energy System Operation

Study of wind plant impact on voltage stability is important to determine a marginal value of power for installed wind units, connected to the main Grid. Calculation at this study helps to support reliable operation of the system providing voltage stability at all nodes of electrical network in spite of wind power fluctuation. Estimation of probability for marginal voltage values distribution with stochastic character of wind power generation is a subject of this paper.

The probabilistic model of system operation at stochastic wind power production may be expressed in the form:

$$\Delta P_i = P_{g(i)}(\lambda) + \tilde{P}_{WT(i)} - P_{H(i)}(\lambda) - \\ -\tilde{U}\sum_{j=1}^{N}\tilde{U}_j (G_{ij}\cos\delta_{ij} + B_{ij}\sin\delta_{ij}) = 0 \quad (6) \\ i \in N = (N_{PU} + N_{PQ})$$

$$\Delta Q_i = Q_{g(i)}(\lambda) + Q_{CR(i)} - \tilde{Q}_{WT(i)} - Q_{H(i)}(\lambda) - \\ -\tilde{U}_i\sum_{j=1}^{N}\tilde{U}_j (G_{ij}\sin\delta_{ij} - B_{ij}\cos\delta_{ij}) = 0 \quad , \quad i \in N_{PQ} \quad (7)$$

where, $P_{g(i)}(\lambda)$ and $Q_{g(i)}(\lambda)$ are generation of active and reactive powers produced by conventional sources of power, connected to node i, $\tilde{P}^t_{WT(i)}$ and $\tilde{Q}^t_{WT(i)}$ are random values of generated active power and consumed reactive power by wind energy sources using observation of wind speed stochastic variation for the certain time interval t, $P^t_{H(i)}(\lambda)$ and $Q^t_{H(i)}(\lambda)$ active and reactive power for load at node i, $Q_{CR(i)}$ is capacity of compensation unit connected to node i, G_{ij} and B_{ij} are active and reactive admittances between i and j nodal points, λ is network loading factor (load increment factor), N is total node numbers as $N = N_{PU} + N_{PQ}$, $\tilde{U}_i$ and $\tilde{U}_j$ are calculated voltages at nodes i and j nodes for assigned values of $\tilde{P}^{tk}_{WT(i)}$ and $\tilde{Q}^{tk}_{WT(i)}$ from random sample $\tilde{P}^{t}_{WT(i)}$ and $\tilde{Q}^{t}_{WT(i)}$, and t_k , k are fixed time value.

Power samples of $\tilde{P}^{tk}_{WT(i)}$ and $\tilde{Q}^{tk}_{WT(i)}$ of total wind turbines production for a certain time periods is set up considering results of calculations and measurement or modeling of wind speed data for time intervals: υ_{sa} - speed then wind turbine (WT) is starting on, υ_{ab} - speed then WT is making stop, υ_{nm} - speed then WT producing nominal power. Taking in account expressions [5] it is possible to evaluate WT power production for various periods of observation as a function of wind speed variations at the speed intervals $\upsilon - \upsilon_{sa}$ and $\upsilon_{nm} - \upsilon_{sa}$.

$$P_{AE} = \begin{cases} 0 & \text{if} \quad 0 \le \upsilon(t) < \upsilon_{3a},\ \upsilon_{ab} \le \upsilon(t) \\ \dfrac{\upsilon - \upsilon_{sa}}{\upsilon_{ab} - \upsilon_{nm}} & \text{if} \quad \upsilon_{sa} \le \upsilon(t) \le \upsilon_{nm} \\ P_{WT(nom)} & \text{if} \quad \upsilon_{nm} \le \upsilon(t) \le \upsilon_{ab} \end{cases} \tag{8}$$

Voltage stability with help of above mentioned probabilistic models is estimated using results of probabilistic load flow analysis by iterative method of calculation. The general description of used algorithm is to be followed.

1. Data collection about conditions of studied energy system (power P, Q of generation and load nodes, limitations on power flow through the transmission lines, nodal voltages).
2. Load flow solution for a base normal regime (nominal values of power at nodes of generation and consumption with nominal wind power production by the plant).
3. Probabilistic load flow solution for wind plant power production at the time intervals defined by daily schedule.
4. Load flow solution in terms of power production received from its random sample by repeating calculation until loads marginal value.
5. Record values of corresponding $P_{\max}$, U_{cr}.
6. To continue evaluation for various values of connected wind power
7. To decrease load for minimal value and at the same time diminish power generation from conventional sources so that there not to be regime limitation. Make evaluation and determine wind plant power generation.
8. Repeat the same for the case of load increase. Determine wind plant power generation.
9. Compose array of samples for calculation variants for different values of connected wind power $P_{\max}$, U_{kp}, P_{wind}.
10. To show a function $P_{\max} \rightarrow P_{wind}$. The value $P^{\lim}_{wind}$ then $P_{\max}$ takes the maximum value is a maximum available power of wind plant connected to the main power system, grid.

III. STUDY RESULTS

Suggested method and algorithm were realized at the Azerbaijan Energy System. Probabilistic characteristics of power generation, its impact on voltage stability, and total available power of connected wind plant with satisfaction of systems voltage stability condition was evaluated.

The simplified circuit of studied system is shown on Figure 1. The network presented in the form of two connected parts. To one of them wind park consisting of wind turbines with unit power of 2.5 MW is connected.

During experiments the gradual increase of installed wind capacity as 50 MW for every stage of development was taken in account. As the results of wind speed probabilistic characteristics and stochastic variations of power generation it was accepted to model these variations at the interval (0-5%), (0-10%), (0-20%).

Results of probabilistic load flow solution for stochastic changes of wind power is done below.

A. Impact of Probabilistic Changes of Wind Plant Generation on Voltage Profile

Modeling is done considering minute measurement of wind speed. Some data fragments of wind speed and wind plant power generation are pictured on Figures 2 and 3.

Relative average value of wind speed at the time of observation is to be formed. Period of measurement is corresponded to the morning peak load of daily demand. As it is seen from the given curve the mean value of wind plant power production at the time of measurement was 15-20 MW (Figure 3).

Considering power production data, the random sample of power values was formed which was used then for repeatable calculation of load flow. The function of voltage changes at the PCC (Figure 1, sub/st. 110 kV Khurdalan) then wind turbine operating with mean speed of 12.5 m/s is presented on Figure 4. As it can be seen from Figure 4 the voltage is changing at the interval of +/- 0.3% relatively to initial value.

B. Regime of Marginal Values of Voltage and Maximal Values of Power Transferred along Transmission Line Connected Wind Plant with Main System

In accordance with described algorithm multivariant iterative load flow calculation for various wind speed observed at typical time of a day was conducted. On the base of wind speed data samples of wind plant power production using models [2] were composed and probability of wind plant power distribution for different periods were formed. For every power value produced by wind plant at various time periods evaluation of trajectories of more heavier regimes till maximum peak load and wind speed variation at the time interval of 5.5-14.5 m/s were performed.

C. Evaluation of Maximal Power of Wind Plant Connected to the Grid in Accordance with Voltage Stability Conditions

To find the maximum available power of wind plant connected to the main network it is necessary to analyze load flow at studied system for different total power of wind turbines and stochastic variation of wind speed. Generalized results of maximal loading values calculation and corresponding to marginal power values critical voltages are collected in Table 1.

From data at Table 1 it is evident that maximum available power of wind plant connected to the energy system equal to 200 MW with critical voltage value of 64.35% from nominal U_{nom}.

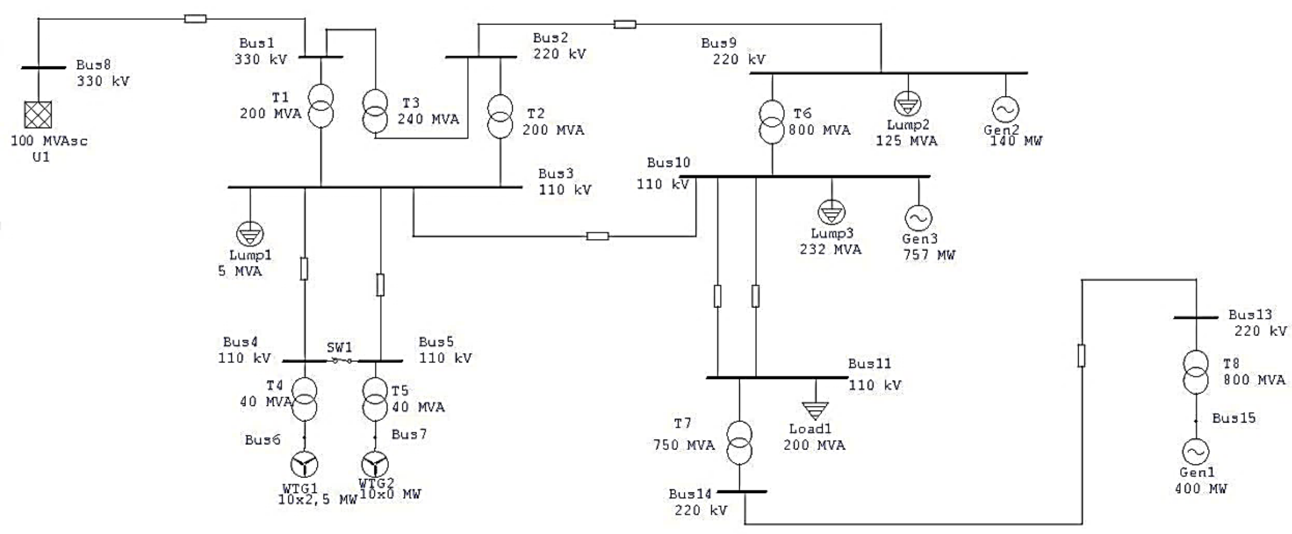

Figure 1. The simplified circuit of studied system

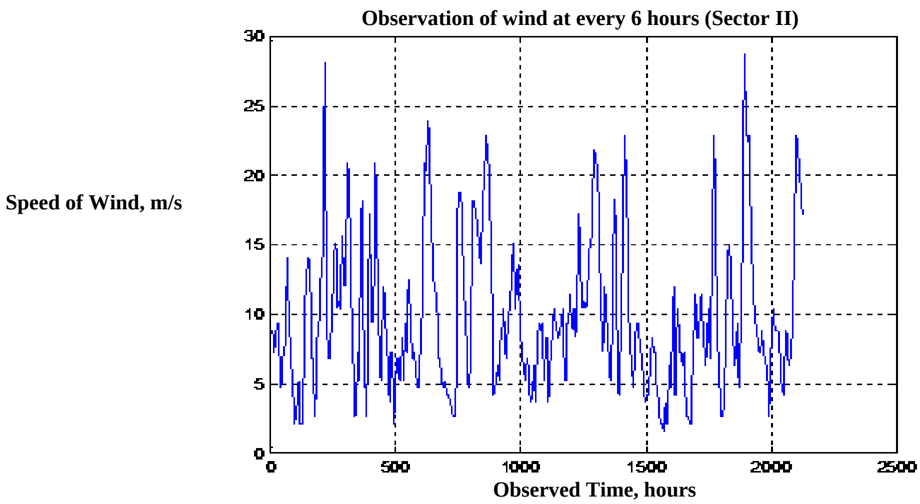

Figure 2. Changes of wind speed made up on subsequent averaging of the minute measuring

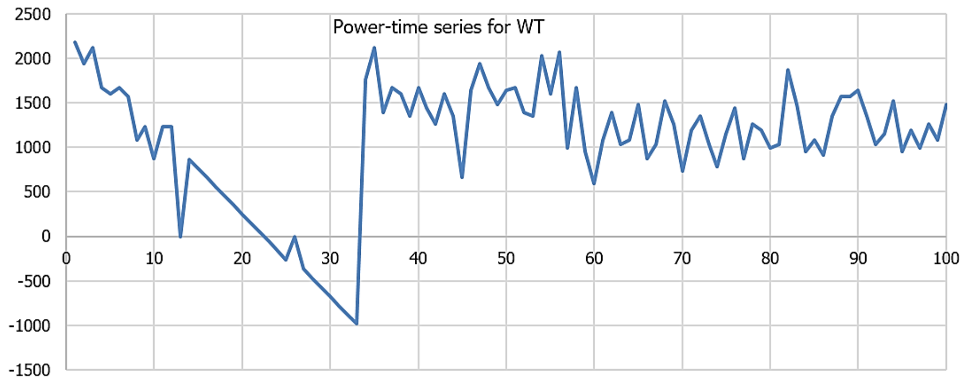

Figure 3. Example of power production by one WT (at wind speed interval 7.0-11.4 m/s)

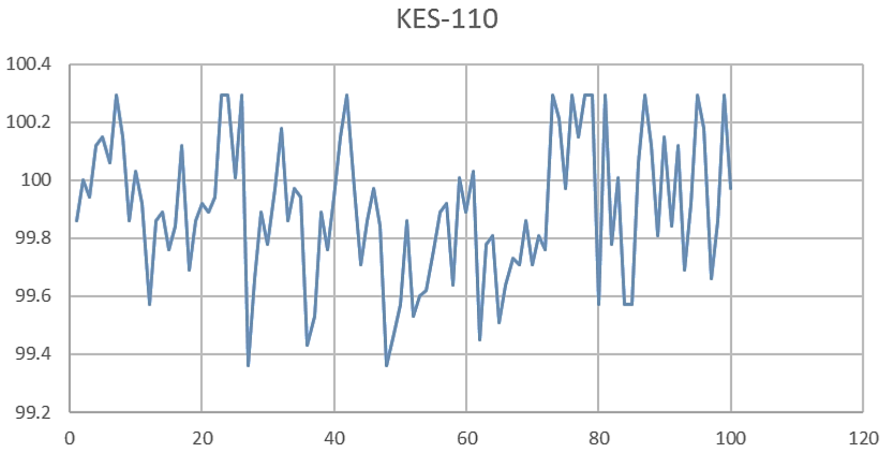

Figure 4. Voltage variation

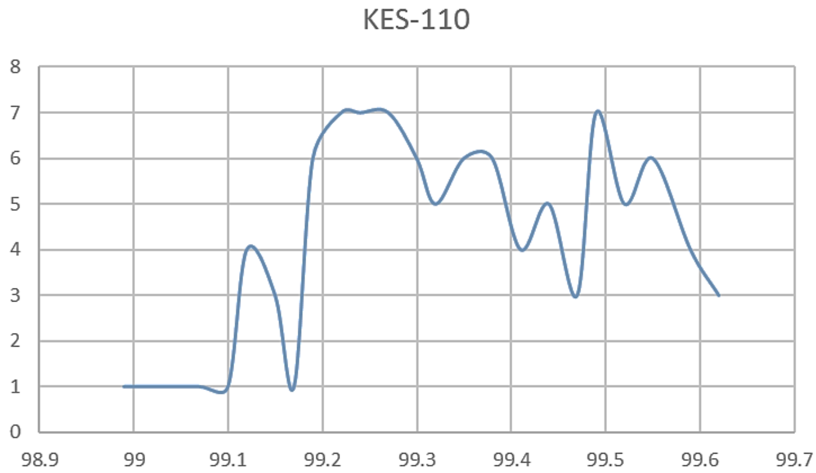

Figure 5. Frequency of voltage distribution

Table 1. Calculation results for various regime of generation and consumption for HV lines at 110 kV Khurdalan substation

Operation and capacity of connected wind power	Calculated values of critical voltage as % from nominal $U_{calc.}$% critical	P_{max} MW	$I_{t,av}$ A	$P_{t,av}$ MW	Voltage values at max. acceptable current U% $I_{t\ accept.}$
No wind generation	61.64	123.5	413.7	73.1	89.72
Wind generation is 50 MW (cosφ=1)	62.12	126.4	413	72.9	89.55
----- » ------ 100 MW (cosφ=1)	62.46	128.4	413.5	73.1	89.71
----- » ------ 150 MW (cosφ=1)	62.76	130.3	413.3	73.1	89.82
----- » ------ 200 MW (cosφ=1)	64.35	131.1	413.9	73.2	89.86
----- » ------ 250 MW (cosφ=1)	64.36	131.1	412.5	73	88.89
----- « ------ 300 MW (cosφ=1)	65.76	130	412.2	72.9	89.86
----- « ------ 350 MW (cosφ=1)	67.07	128.1	412.7	73	89.78
----- « ------ 400 MW (cosφ=1)	68.23	124.8	412.8	72.9	89.66
----- « ------ 50 MW (cosφ=0.95)	61.53	122.8	412.8	72.8	89.17
----- « ------ 100 MW (cosφ=0.95)	62.6	12.7	413.5	72.8	88.97
----- « ------ 150 MW (cosφ=0.95)	63.64	118	413.1	72.7	88.74
----- « ------ 200 MW (cosφ=0.95)	64.36	113.1	413.6	72.4	88.13

IV. CONCLUSION

1. Penetration of wind and solar PV units to the power system are creating new challenges on every stage of a development which can be as following:
- addition to the main power system energy sources with intermittent and uncertain character of generation;
- growth of systems with distributed generation with hybrid power sources;
- the placement of wind or PV solar power plants is not determined economical factor of being close to the nodes of consumption;
- creation of new software for control and analysis of power system operation with probabilistic modeling.

2. To estimate an impact of these challenges study of regime variations at the time of commissioning of a new

wind power generation was conducted. Mainly this study may be characterized by following results:
- model of probabilistic load flow with connected wind plant is developed;
- algorithm for evaluation of static voltage stability margin taking in consideration stochastic nature of produced wind power;
- method to estimate maximum acceptable wind power which can be put into the main power system with voltage stability was suggested;
- The suggested method and algorithm have been tested on real energy system.

REFERENCES

[1] C. Sourkounis, P. Touron, "Grid Code Requirements for Wind Power Integration in Europe", Institute for Power System Technology and Power Mechatronics, Ruhr-University Bochum, Germany, Article ID 437674, 2013.

[2] I. Hossain, "Wind Energy 2050", World Wind Energy Association, Grid Integration Report, p. 84, October 2015.

[3] J.D. Rose, I.A. Hiskens, "Challenges of Integrating Large Amounts of Wind Power", 1st Annual IEEE Systems Conference, pp. 1-7, 2007.

[4] R. Lis, M. Sobierajski "Integration of Distributed Resources in Power Systems", Wroclaw University of Technology, Wroclaw, Poland, p. 235, 2011.

[5] H. Holttinen, P. Meibom, A. Orths, B. Lange, et al., "Design and Operation of Power Systems with Large Amounts of Wind Power", Final Report, IEA Wind Task 25, Phase One 2006-2008, Helsinki, p. 239, 2009.

[6] International Standard IEC 61400-21, "Wind Turbine Generator Systems - Part 21: Measurement and Assessment of Power Quality Characteristics of Grid Connected Wind Turbines", First Edition, 2012.

[7] A.D. Hanseu, G. Michalke, "Fault Ride-through Capability of DFIG Wind Turbines", Renewable Energy, Vol. 32, pp. 1594-1610, 2007.

[8] N.R. Rahmanov, H.B. Guliyev, "Application of Neuron Modeling to Estimate Power Systems Voltage Stability", Elektrichestvo, No. 4, Moscow, Russia, pp. 4-11, 2015.

[9] E. Muljadi, C.P. Buuterfield, J. Chacon, H. Romanowitz, "Power Quality Aspects in a Wind Power Plant", IEEE Power Engineering Society General Meeting, 2006.

[10] E. Vittal, M.O. Malley, A. Keane, "A Steady-State Voltage Stability Analysis of Power Systems with High Penetrations of Wind Energy", IEEE Transactions on Power Systems, Vol. 25, No. 1, pp. 433-442, 2009.

[11] A.M. Hashimov, N.R. Rahmanov, H.B. Guliyev, "Improved Algorithm of Fuzzy Logic to Control Reactive Power and Voltage Distribution Networks", International Scientific and Technical Journal of Higher Educational Institutions and Associations of the CIS Energy, Minsk, Belorussia, No. 2, pp. 29-39, 2014.

[12] J. Shi, Y.J. Tang, L. Ren, J.D. Li, S.J. Chen, "Application of SMES in Wind Farm to Improve Voltage Stability", Physics C. Superconductivity, Vol. 468, No. 15-20, pp. 2100-2103, 2008.

[13] A. Sode Yome, N. Mithulananthan, K.Y. Lee, "Static Voltage Stability Margin Enhancement Using STATCOM, TCSC and SSSC", IEEE/PES Transmission and Distribution Conference and Exhibition, Asia and Pacific, Dalian, China, 2015.

[14] M.R. Shadmesgaran, A.M. Hashimov, N.R. Rahmanov, "Optimal Location and Capacity of Parallel FACTS Devices in Order to Improve Voltage Static Stability and Power Losses Reduction Using Genetic Algorithm", 12th International Conference on Technical and Physical Problems of Electrical Engineering (ICTPE-2016), Bilbao, Spain, 7-9 September 2016.

[15] J.S. Huang, Z.H. Jiang, M. Negnevitsky, "Loadability of Power Systems and Optimal SVC Placement", Electrical Power and Energy Systems, Vol. 45, pp. 167-174, 2013.

[16] J. Morren, "Grid Support by Power Electronic Converters of Distributed Generation Units", Delft University of Technology, Delft, Netherlands, 2006.

[17] Z. Zeng, G. Yang, H. Geng, "High Voltage Ride-through Control Strategy of Grid-Side Converter for DFIG-Based WECS", 39th Annual Conference of IEEE Industrial Electronics Society (IECON 13), pp. 5582-5587, Vienna, Austria, November 2003.

[18] D. Ananth, G. Nagesh Kumar, "Fault Ride-through Enhancement Using Enhanced Field Oriented Control Technique for Converters of Grid Connected DFIG and STATCOM for Different Types of Faults", ISA Transactions, 2015.

[19] M. Mohseni, M. Masoum, S. Islam, "Low and High Voltage Ride-through of DFIG Wind Turbines Using Hybrid Current Controlled Converters", Electric Power Systems Research, Vol. 81, No. 7, pp. 1456-1465, 2011.

[20] E.I. Erlich, N. Winter, A. Dittrich, "Advanced Grid Requirements for the Integration of Wind Turbines into the German Transmission System", IEEE Power Engineering Society General Meeting, 2006.

[21] N.R. Rahmanov, "Estimation of Power Flows in the Network with Distributed Generation, Taking into Account the Uncertainty of Development and Consumption", International Scientific Seminar on Methodical Research Questions in the Reliability of Large-Scale Power Systems, Reliability Liberalized Energy Systems, Issue 65, St. Petersburg, Russia, pp. 511-516, 2015.

[22. N.K. Saxena, A. Kumar, "Effect of Probabilistic Pattern on System Voltage Stability in Decentralized Hybrid Power System", World Journal of Engineering and Technology, Vol. 3, 195-204, 2015.

[23] S.Q. Bu, "Probabilistic Analysis of Small Signal Stability of Large Scale Power Systems as Affected by Penetration of Wind Generation", IEEE Transactions on Power Systems, Vol. 27, No. 2, pp. 762-770, 2012.

[24] V. Ajjerapu, C. Christy, "The Continuation Power Flow: A Tool for Steady State Voltage Stability Analysis", IEEE Transactions on Power Systems, Vol. 7, No. 1, pp. 416-423, February 1992.

BIOGRAPHIES

Nariman R. Rahmanov received the M.Sc. and Ph.D. degrees from Azerbaijan State Oil and Chemistry Institute (Baku, Azerbaijan) in 1960 and 1968, respectively. He received the Doctor of Technical Sciences in Power Engineering from Novosibirsk Electro technical Institute, Russia in 1990. He is a Professor since 1990 and Director of Azerbaijan Scientific Research Institute of Energetic and Energy Design (Baku, Azerbaijan) from 2007 up to 2009, and Deputy Director of the same institute and SPII from 2009 up to present. He is Director of Azerbaijan-Norway Center of Cleaner Production and Energy Efficiency (CPEE Center). He is the member of IEEE, Academician of International Eco-Energy Academy (Baku, Azerbaijan), Co-Chairman of International Conference on "Technical and Physical Problems of Electrical Engineering" (ICTPE), member of Editorial Boards of International Journal on "Technical and Physical Problems of Engineering" (IJTPE) and Journal of Power Engineering Problems. His publications are more than 200 articles and patents, and also 3 monographs. His research areas are power systems operation and control, distributed systems, alternative energy sources. His publications are more than 210 articles and patents, and also 3 monographs.

Javier Bilbao obtained the degree in Electrical Engineering from University of the Basque Country, Spain, in 1991. At present he is Ph.D. in Applied Mathematics and Professor at the Department of Applied Mathematics of that university. He has been General Chairman of some conferences of WSEAS organization. His current and previous research interests are Distribution overhead electrical lines compensation, optimization of series capacitor batteries in electrical lines, modelization of a leakage flux transformer, losses in the electric distribution networks, artificial neural networks, modelization of fishing trawls, E-learning, noise of electrical wind turbines, light pollution, and health risk of radiofrequencies. He is the General Chairman of International Conferences on Engineering and Mathematics (ENMA) and member of committees of International Conference on Technical and Physical Problems of Electrical Engineering (ICTPE).

Naser Mahdavi Tabatabaei was born in Tehran, Iran, 1967. He received the B.Sc. and the M.Sc. degrees from University of Tabriz (Tabriz, Iran) and the Ph.D. degree from Iran University of Science and Technology (Tehran, Iran), all in Power Electrical Engineering, in 1989, 1992, and 1997, respectively. Currently, he is a Professor in International Organization of IOTPE (www.iotpe.com). He is also an academic member of Power Electrical Engineering at Seraj Higher Education Institute (Tabriz, Iran) and teaches power system analysis, power system operation, and reactive power control. He is the General Chair and Secretary of International Conference of ICTPE, Editor-in-Chief of International Journal of IJTPE and Chairman of International Enterprise of IETPE all supported by IOTPE. He has authored and co-authored of 7 books and book chapters in Electrical Engineering area in international publishers and more than 140 papers in international journals and conference proceedings. His research interests are in the area of power system analysis and control, power quality, energy management systems, ICT in power engineering and virtual e-learning educational systems. He is a member of the Iranian Association of Electrical and Electronic Engineers (IAEEE).

Oktay Z. Kerimov graduated from Azerbaijan Industrial Institute (Baku, Azerbaijan) as a Mechanical Engineer in Automation Control. He received the Ph.D. degree from Moscow Institute of Power, Russia in 1970. He was Senior Researcher in Azerbaijan Institute of Power (Baku, Azerbaijan) from 1962 till 1981. He was a Visiting Scholar in UC Berkeley, CA, USA from 1977 till 1978. He also was an advisor on Power Systems in Park Holding, Turkey at the period of 1993-2004. At 2005 he joined again to Azerbaijan Institute of Power as the Head of Energy Saving and Efficiency Laboratory.

Rahman N. Rahmanov was born in Baku, Azerbaijan, on October, 4 1979. He received the B.Sc. and M.Sc. degrees in Electrical Engineering from Azerbaijan State Oil Academy, Baku, Azerbaijan in 2000 and 2002, respectively. In 2006, he obtained Ph.D. from Azerbaijan Research Institute of Energetics and Energy Design, Baku, Azerbaijan, and University of Manchester, Project Management Course (in progress), Corporate Member of Institute of Engineering, and Technology CEng. His research interests are distributed generation, nonlinear networks, system optimization and operation.