Latvian Electrical Power System Stability's Analysis Taking into Account New Development Strategy Until 2025

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***Abstract*— Energy is one of the sectors directly affecting the economic growth and forming a significant part of overall expenses in several industry branches, especially in manufacturing. The development of the energy sector requires significant investments which can only be attracted in a stable and predictable investment environment. Therefore, Latvian energy sector is being planned in a long-term both globally and at the European Union (EU) level. During the last two decades, increase in electricity demand and environmental concern resulted in fast growth of power production from renewable sources, where wind energy is one of the most efficient alternatives. The second important moment is the Baltic power system's development strategy, with the breakdown of continental Europe from the energy circle of BRELL until 2025. The purpose of this paper is devoted to the evaluation sufficiency of measures taken, taking into account integration of a large wind farm in the Latvian Electric Power System (EPS) in terms of stability. As well as proposed methods for detection of network parameters that are most vulnerable (voltage drop) to external impacts (sensors), determine their relationship with EPS parameters, try to use this information for improvement of EPS behavioural properties. Thus, availability of information on the location of sensors allows determining and controlling nodes, in which the biggest oscillations of operational parameters are observed due to disturbances in the system.**

***Keywords*— power system stability, Baltic energy system's synchronization with Europe, wind energy integration, power system modelling**

REFERENCES

[1] http://www.ast.lv/eng/power_system/current_situation_in_power _system/state_of_power_system/
[2] Cabinet of Ministers Ordinance no.129 Energy Development guidelines 2016-2020 (Latvian)
[3] National Energy Efficiency Action Plan for 2014-2020
[4] Criteria and Countermeasures for Voltage Collapse. CIGRE TF 38.02.12. Final report // Electra. – 1991. – № 124 – P. 118–132.
[5] Approaches to the Security Analysis of Power Systems: Defence Strategies Against Malicious Threats / E. Bompard [et al.] // Office for Official Publications of the European Communities. – 2007. – 51 p.
[6] Voropay, N.I. Analysis of the systemic failures of the mechanisms in the EPS / N.I. Voropay, D.N.Efimov, V.I. Reshetov – 2008. – № 10. – pp. 12–24.
[7] Wasley, R.G. Identification and ranking of critical contingencies in dependent variable scale / R.G. Wasley, M. Danesdoost // IEEE Trans. Power Appar. and Syst. – 1983. – Vol. 102, № 4. – P. 881–892. 014
[8] Analysis of electric power systems of inhomogeneities /O.N. Voytov. – Novosibirsk: Science; Sib. Dep-of RAN, 1999. – 256 c.
[9] Gamm, A. Z. Sensors and weaknesses in the electric power systems / A. 3. Gamm, I. I. Golub. – Irkutsk: Science; Sib, 1996.– 99 p.
[10] Electromechanical transient processes in electrical systems. - Riga 2012-P.22.
[11] Nepomnyaschiy, V., Gerhards, J., Mahņitko, A., Lomane, T. Reliability of Latvian Power System's 330 kV Substations. Latvian Journal of Physics and Technical Sciences, 2014, Vol.51, Iss.3, pp.15-23. ISSN 0868-8257. Available from: doi:10.2478/lpts-2014-0016
[12] Papkov, B., Gerhards, J., Mahņitko, A. System Problems of Power Supply Reliability Analysis Formalisation. In: 2015 IEEE 5th International Conference on Power Engineering, Energy and Electrical Drives (POWERENG): Proceedings, Latvia, Riga, 11-13 May, 2015. Riga: Riga Technical University, 2015, pp.225-
228. ISBN 978-1-4673-7203-9. e-ISBN 978-1-4799-9978-1. e-ISSN 2155-5532. Available from: doi:10.1109/PowerEng.2015.7266324
[13] Soboļevskis A., Zicmane I., Murach V. "Vulnerability assessment of electric power system for the case of Latvian EPS", 2015 56th International Scientific Conference on Power and Electrical Engineering of Riga Technical University, Riga, 2015.
[14] [13].Soboļevskis A., Zicmane I., "Analysis of vulnerability of the Latvian electrical power system" 2016 16 IEEE International Conference on Environment and Electrical Engineering, La Palazzina de' Servi, Florence, Italy, 2016.
[15] Soboļevskis A., Zicmane I., "Assessing the Impact of Registering of Weak Points Calculating the Power System Operating Modes", 2016 57th International Scientific Conference on Power and Electrical Engineering of Riga Technical University, Riga, 2016.
[16] Soboļevskis A., Zicmane I., "Prediction Of Latvian Electrical Power System For Reliability Evaluation Including Wind Energy" 17th IEEE International Conference on Environment and Electrical Engineering, , Milan, Italy, 2017.
[17] Sauhats A., Utans A., Antonovs D., Biela-Dalidovicha E. Outof- step protection using equal area criterion in time domain // 2016 57th International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON), [Riga, Latvia, 13-14 October 2016]: Conference Proceedings. Riga: Riga Technical University, 2016, pp.19-24. ISBN 978-1-5090-3729-2; e-ISBN 978-1-5090-3731-5. DOI: 10.1109/RTUCON.2016.7763112.
[18] Petrichenko R., Chuvychin V., Sauhats A., Strelkovs V. Development and integration of adaptive underfrequency load shedding into the smart grid // 2017 IEEE International Conference on Environment and Electrical Engineering and 2017 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 6-9 June 2017, Milan, Italy. Piscataway, NJ: IEEE, 2017, art. no. 7977490. ISBN 978-1-5386-3918-4; e-ISBN 978-1-5386-3917-7. DOI: 10.1109/EEEIC.2017.7977490.
[19] Sauhats A., Coban H.H., Baltputnis K., Broka Z., Petrichenko R., Varfolomejeva R. Optimal investment and operational planning of a storage power plant // International Journal of Hydrogen Energy, Vol.41, iss.29, 2016, pp.12443-12453. ISSN 0360-3199. DOI: 10.1016/j.ijhydene.2016.03.078.
[20] Kuznecovs T., Mahnitko A., Sauhats A., Oboskalov V. Power flow studies for assessment the security of steady states in zone inside the large interconnected power system // Procedia Computer Science, Vol.104, 2017, pp.421-428. ISSN 1877-0509. DOI: 10.1016/j.procs.2017.01.155.
[21] Sauhats A., Utans A., Antonovs D., Svalovs A. Angle controlbased multi-terminal out-of-step protection system // Energies, Vol.10, iss.3, 2017, Article number: 308 (16 pages). ISSN 1996-1073. DOI: 10.3390/en10030308