DOI: https://doi.org/10.15407/ techned2017.04.029

THE NUMERICAL-FIELD ANALYSIS OF POWER AND ENERGY PROCESSES IN THE TURBO-GENERATOR AT LOAD UNBALANCE

Journal	Tekhnichna elektrodynamika
Publisher	Institute of Electrodynamics National Academy of Sciences of Ukraine
ISSN	1607-7970 (print), 2218-1903 (online)
Issue	No 4, 2017 (July/August)
Pages	29 – 35

Authors
V.I. Milykh, D.V. Pototskyi
National Technical University “Kharkov Polytechnic Institute”,
2, Kyrpychova str., 61002, Kharkiv, Ukraine,
e-mail: mvikemkpi@gmail.com

Abstract

Assessing the impact of load asymmetry of turbo-generator (TG) on the power and energy processes in it based on the numerical-field analysis within the constraints regulated by the standards. ***Methodology****. Mathematical model of TG has been constructed on the method of symmetrical components of the three-phase current system. The unbalanced system of the currents is used for calculations of rotating magnetic fields. Thus the temporal functions of the electromagnetic and power quantities which are subjected to the harmonic analysis are obtained.* ***Results****. Calculations are conducted on a three-phase 35 MW TG during its work under autonomous unbalanced loading. The analysis of the temporal functions of the electromagnetic torque and the forces acting on the winding cores and the*

stator core ferromagnetic part has been executed. The distribution of power of their coefficients according to the phase windings was revealed. ***Originality***
. Problems of the TG exploitation at unbalanced loading are detected by the consideration of its electromagnetic system on the whole, but not its simplified local parts, as usual. The basis of the analysis is a new method constructed on the discrete temporal functions of the various quantities revealed by a multiposition numerical calculations of rotating magnetic fields.
Practical value
. Analysis of the TG work at unbalanced loading showed the problems of a power and electromagnetic character. It is shown that the temporal functions of the forces acting on the stator core rods and its tine generally similar to what it was at the symmetrical load, but the compressive forces acting on the core in general increased. Electromagnetic moment has a very strong pulsation which amplitude reaches 23% of its average value. The powers and their phase windings coefficients are distributed very unevenly. The TG design problems, the solutions of which must take into account the information received, are indicated. This makes it possible to provide for measures to ensure a durable and reliable operation of the TG.
References 10, figures 6, tables 3.

Key words: turbo-generator, unbalanced loading, magnetic fields, numerical calculations, action of the force, temporal functions, power distribution.

Received: 27.09.2016
Accepted: 16.03.2017
Published: 15.06.2017

References

1. Vaskovskyi Yu.M., Melnyk A.M. The electromagnetic vibration disturbing forces in

turbogenerator with a glance of current asymmetry of stator winding. *Tekhnichna Elektrodynamika.* 2017. No 1. Pp. 52–57. (Ukr)

2. Zozulin Yu.V., Antonov O.Ye., Bychik V.M., Borychevskyy A.M., Kobzar K.O., Livshyts O.L., Rakohon V.H., Rohovyy I.Kh., Khaymovych L.L., Cherednyk V.I. Creation of new types and modernization of the existing turbogenerators for the thermal electric stations. Kharkiv: PF «Kolehium», 2011. Pp. 68–76. (Ukr)

3. Milykh V.I. Organization of the numerical-field calculations of electromagnetic processes in a turbogenerator at its asymmetrical loading. *Visnyk Natsionalnoho Tekhnichnoho Universytetu KhPI. Seriia Elektrychni mashyny ta elektromekhanichne peretvorennia enerhii*. 2016. No 11 (1183). Pp. 3–10. (Rus)

4. Milykh V.I. The numerically-field analysis of electromagnetic processes in the turbo-generator rotor under unbal-anced loading. *Tekhnichna Elektrodynamika*. 2017. No 3. Pp. 49–57. (Rus)

5. Milykh V.I., Polyakova N.V. Numerically-field calculations of the electromagnetic parameters of turbogenerators. *Visnyk Natsionalnoho Tekhnichnoho Universytetu KhPI. Seriia Elektrychni mashyny ta elektromekhanichne pere-tvorennia enerhii.* 2014. No 38(1081). Pp. 3–18. (Rus)

6. Titko O.I., Vaskovskyi Yu.N., Kramarskyi V.A., Kuchynskyi K.A., Ahremenko V.L. Physical aspects of a problem reliability and efficiency of powerful turbogenerators. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy*. 2011. No 29. Pp. 90–103. (Ukr)

7. Claudio Bruzzese. 2-Pole turbo-generator eccentricity diagnosis by split-phase current signature analysis. 2013 9th IEEE International Symposium on *Diagnostics for Electric Machines, Power Electronics and Drives* (SDEMPED). 2013. Pp. 349–357. DOI: https://doi.org/10.1109/DEMPED.2013.6645739

8. Denisa Rusinaru, Leonardo Geo Manescu, Marian Ciontu, Miron Alba. Three-phase load flow analysis of the unbalanced distribution networks. 2016 International Conference on *Applied and Theoretical Electricity* (ICATE). 2016. Pp. 1–5. DOI: https://doi.org/10.1109/ICATE.2016.7754621

9. Finite Element Method Magnetics : OldVersions. FEMM 4.2 11Oct2010 Self-Installing Executable. Avaliable at: http://www.femm.info/wiki/OldVersions .

10. Tiago Soares, Vitor; José Carlos, M. Vieira. Optimal voltage regulation in distribution systems with unba-lanced loadsand distributed generation. 2016 IEEE *Innovative Smart Grid Technologies – Asia* (ISGT-Asia). 2016. Pp. 942–947. DOI: https://doi.org/10.1109/ISGT-Asia.2016.7796512

PDF