A stationary DC decay test on the 7.5 MVA turbogenerator installed in a thermal power plant

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Abstract **A measurement-based model parameter estimation in both d and q axis of a synchronous generator is presented. The test is carried out while the machine is at standstill. It is an interesting measurement method, especially when other tests are difficult to perform.**

Keywords **synchronous generator, mathematical models, parameter estimation, transient states.**

I. INTRODUCTION

In industrial generating units (coal-mines, thermal power plants) there are clear difficulties in practical application of test disturbances such as step changes of the voltage regulator reference voltage as well as in introduction of additional test signals, for instance pseudorandom signals PRBS, described in literature [1]. The methods realized based on measurements taken at machine standstill, for instance with use of the DC decay test, are the alternative [2].

II. INVESTIGATIONS

Investigations were performed in Mikołaj Power Plant in which there is installed a synchronous generator of the ratings: S_n = 7,5 MVA, U_n = 6,3 kV and cosφ = 0,8. The schematic diagram of the measuring system is shown in Fig. 1.

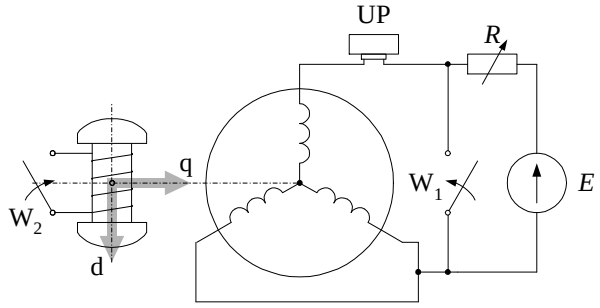

Fig.1. Schematic diagram of the measuring system for recording dynamic waveforms during current decay in the armature winding

The estimation of turbogenerator electromagnetic parameters was carried out for the R-L models of type 2,2 and X-T. The diagrams and equations corresponding to the models analysed can be found in [1].

III. RESULTS OF PARAMETER ESTIMATION

The calculations of electromagnetic parameters of selected models were made by minimising the objective function (1) and (2) for parameters estimated in d and q axis, respectively:

$$\varepsilon_d(\boldsymbol{P}) = \sum_{k=1}^{n}\left(I_{dmk} - I_{dak}(\boldsymbol{P})\right)^2, \quad \varepsilon_q(\boldsymbol{P}) = \sum_{k=1}^{n}\left(I_{qmk} - I_{qak}(\boldsymbol{P})\right)^2, \qquad (1),(2)$$

when taking into account in this function the approximated waveforms (measured – index m) and the approximating waveforms (index a) of the decaying current in the connected windings of the armature (Fig. 2) obtained based on the model expressed by the searched parameters ***P***. The exemplary calculation results are given in Table I.

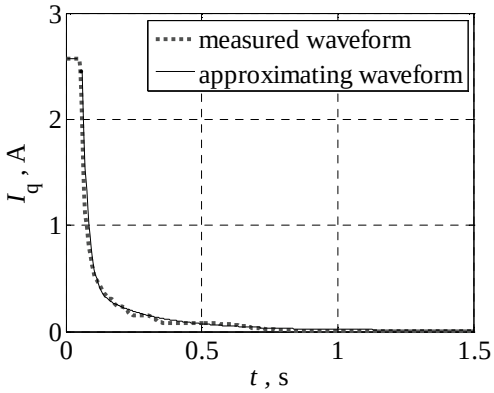

Fig.2. Dynamic waveforms of the armature decaying current at the field magnet winding open and located transversely to the armature flow (q-axis)

TABLE I
EXEMPLARY RESULTS OF PARAMETER ESTIMATION OF SYNCHRONOUS GENERATOR MODELS

Synchronous generator model parameters in q axis			
X-T model		R-L model of type 2,2	
X_q, p.u.	532,20e-3	R_{Q1}, p.u.	0,46e-3
X'_q, p.u.	301,54e-3	$L_{\sigma Q1}$, p.u.	339,01e-3
X''_q, p.u.	2,74e-3	R_{Q2}, p.u.	3,28e-3
T'_{q0}, s	5200,70e-3	$L_{\sigma Q2}$, p.u.	0,13e-3
T''_{q0}, s	181,45e-3	L_{aq}, p.u.	417,80e-3

IV. CONCLUSIONS

The presented current decay method is easy to be realized on an industrial generating unit. In the case of possibility of realizing test disturbances during turbine set operation it is a valuable tool for verification of the results obtained.

V. REFERENCES

[1] Paszek S.: Selected methods for assessment and improvement of power system angular stability. Silesian University of Technology Publishing House, Gliwice, 2012.

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