ISSN 2222-2944. Інформаційні технології: наука, техніка, технологія, освіта, здоров’я. 2023

EFFECT OF CHANGING THE TURBOGENERATOR AIR GAP VALUE ON THE ITS PARALLEL OPERATION STABILITY WITH POWER SYSTEM

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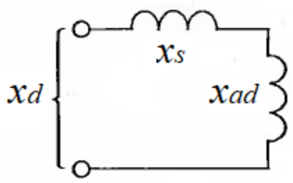
During the global energy crisis, power plants in Ukraine, as well as at plants in many countries, operate turbogenerators (TG), the operating time of which exceeds the period set by the manufacturer. This condition of the condition equipment requires constant monitoring, the development of special maintenance and repair programs. It is necessary to understand how technological deviations caused by the wear individual elements will affect the productivity of the TG. In particular, we analyzed the effects of changing the air gap value (appearance of gap unevenness due to wear of support bearings, deviation of the rotor core from a cylindrical shape, etc.) on the stability of the generator parallel operation with the power system. To perform such an assessment, we considered the change in the TG synchronous inductive resistance along the longitudinal axis x_d. The stator winding total inductive resistance characterizes the steady state mode of the TG (normal or steady short circuit mode:

$$x_d = x_{ad} + x_s, \text{ Ом},$$

where x_{ad} – is the longitudinal anchor reaction inductive reactance, Ohm; x_s – the dissipation resistance stator winding, Ohm.



The value of the synchronous inductive reactance x_d can be written:

$$x_d = \frac{A.\tau}{B_\delta.\delta};$$

where A – the stator linear electrical load, A/m; B_δ – induction in the air gap, T; τ – pole division of the stator, m; δ – the air gap size, m. Magnitude x_d is inversely proportional depends on the air gap size, as the value A, B_δ and τ are defined during design and maintained during operation (A and B_δ).

In places where the gap increases, the induction decreases, because. magnetic resistance increases. Therefore, it is necessary to increase the excitation winding magnetizing force ($F_{fw}=I_{fw}\cdot w_{fw}$, A, where I_{fw} – is the direct current in the field winding, A; w_{fw} – the number of field winding turns). This increases the current density in the field winding, which requires an increase in the cooling intensity. In areas where the air gap decreases, the cooling of the generator core deteriorates, and the value of the maximum transmitted power also decreases P_{max}, i.e. the static stability limit of the generator is reduced. Maximum transmitted power to the power system $P_{max}=E_q\cdot U_c/(x_d+x_{net})$, where E_q – longitudinal component of the EMF of idling; U_c – busbar voltage of the power system; x_{net} – inductive resistance of the TG communication section with the power system.

It can be concluded that a change in the TG air gap value, caused by the wear of individual elements of the machine, will cause an increase in temperature and a decrease in the generator static stability. Therefore, in order to ensure the possibility of the TG further operation at the power plant unit during overhauls, it is necessary to reconstruct individual elements of the TG, replaces the standing bearings bushings in a timely manner, perform additional balancing of the rotor, and intensify cooling.