UNDERCOMPENSATING OF REACTIVE ENERGY IN THE NETWORK AS A CAUSE OF POSSIBLE OVERVOLTAGE IN THE ASYNCHRONIZED GENERATORS FIELD WINDINGS

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One of the effective ways to regulate the active and reactive power balance to maintain the required voltage and frequency levels in power systems is the use of asynchronized synchronous generators (ASG). Despite the fact that the experience of operating ASG in different countries shows positive results, breakdowns of the field windings insulation were quite often noted [1]. Basically, such accidents were noted for generators that often operate in transient modes and especially for machines that were operated by consuming reactive power from the system. The transfer of generators to such modes was caused by the need to regulate active and reactive power in networks. the need to compensate for reactive power. This problem is determined by the fact that high-voltage power lines (HVPLs) are long and are not sufficiently loaded with active current. In addition, in networks of different voltage classes, there is an uneven distribution of reactive power flows, table. 1.

Table 1. Levels of reactive power compensation in the Ukrainian energy system

Voltage of HVPLs, kV	Every 100 km, reactive power is generated into the electrical network, Mvar	Reactive power compensation level, %	
		secured	recommended
220	11	-	20-25
330	30	~10	50
500	90	45	80-100
750	230	75	100-110

Therefore, voltages in overhead power lines often exceed permissible values by 10-15%, which increases wear and tear of electrical equipment of power plants.

The most severe conditions (from the point of overvoltage view) are associated with transient modes, when the aperiodic currents of the stator winding are maximally manifested. These include: operating modes of ASG on a network with undercompensating of reactive power; in case of three-phase short circuits near the generator; using a self-synchronization method at startup, etc. In transient modes, aperiodic components appear in the stator current, inducing an EMF in the rotor phases with the rotation frequency. This EMF with a large number of rotors winding turns can exceed the rated voltage of the stator winding. The voltage in the rotor winding is determined by the exciter, but in this case the distribution of potentials along the length of the winding and around the rotor circumference will be uneven, which causes overvoltage in individual sections. Thus, one of the reasons for overvoltage on the ASG field windings is non-stationary processes in the generator windings circuits, arising due to insufficient compensation of reactive energy in the network.

References:

1. Dovganyuk I.Y., Plotnikova T.V., Sokur P.V. Excitation system of asynchronized turbo-generators. Power Technol Engineering, 2004, no. 38, pp. 359–364. doi: 10.1007/s10749-005-0013-1