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# Methods of defining generator synchronizing power and energy during low frequency oscillations

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## Abstract

The report intended to become a springboard for discussion is devoted to the issue of quantitatively estimating the power system generator interoperation during low frequency oscillations (LFO).

Large-scale centralized power systems interconnected by the weak tie-lines is a typical feature of the state-of-the-industry power engineering. Another trend is distributed generation units integration. Changes in electric power production and consumption structure result in decreasing power system inertia constant and increasing sensitivity to disturbances.

LFO in power systems arising due to disturbances or developing under stressed conditions threaten the equipment secure operation and the consumers power supply as well. Effective LFO detection with the corresponding countermeasures along with eliminating the prerequisites leading to the oscillations is a guarantee of minimizing their negative consequences.

During the LFO it is of crucial importance to monitor the damping capability of the generators in power system. These capabilities are influenced by the generators regulators adjustment to a large extent.

To estimate the synchronous generator capability to maintain synchronous operation under deviating frequency and load angle conditions synchronizing torque and corresponding synchronizing power are proposed to be used.

The possibility to determine the synchronous machine synchronizing power is subject to the presence of the load angle variation data while the primary barrier is the absence of the corresponding direct measurement. We have developed the techniques for deriving the synchronous machine load angle without direct measurement using the electrical parameters measurements. Numerous physical simulations have been carried out in order to estimate the effect of assumptions made.

Major efforts have been aimed at developing and implementing the generator load angle direct measurement system. The system has become the part of the electrodynamic model with the resulting opportunity to compare the estimated and directly measured load angle values taking into account the nonlinear characteristics of the actual machine.