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IMPROVING THE RELIABILITY OF SIMULATING THE OPERATION OF AN INDUCTION MOTOR IN SOLVING THE TECHNICAL AND ECONOMIC PROBLEM

Noisy electricity within workshop networks of industrial enterprises affects unfavorably the performance of electromechanical transducers, i.e. asynchronous alternating-current motors. Unsymmetry and anharmonicity of three-phase networks as well as their harmonic components result in the increased temperature of the motor windings; the decreased power coefficient and efficiency; the increased amount of reactive power being consumed; and the reduced service life. The above-mentioned worsens operational capability along with the electric equipment reliability while reducing the performance efficiency on the whole.

Minimization of the noisy electricity effect on the performance efficiency can be achieved at the expense of the use of “individual” LC-filters, and “cluster” devices to compensate effect of such noisy electricity at a workshop level; as well as at the expense of control of supply voltage distortion within the areas of its onset. Certain measures may also be untaken if they are not expedient economically.

Each of the listed alternatives is characterized by a specific implementation cost, and economic potential. Selection of one of them is rather complex problem being solved in terms of computer-based experiments.

It is a well-known fact that there is certain negative effect of poor-quality power supply upon operational characteristics of induction motors (IM) [1]. Reduced quality of power voltage results in pulsation of the moment generated by the motor, drop of starting and critical IM moment, increase in vibration, early wear of bearing and gear components, increased steel losses due to higher harmonic field constituents in a gap, reduction in such power indices of induction motor operation as efficiency coefficient and power coefficient. Moreover, availability of noisy electric energy within workshop grids of industrial enterprises results in the accelerated physical ageing; in the decreased power efficiency of equipment in use; and in the increased risk of industrial emergency situations. Paper [2] has shown that the problem solution should be sought at technical-and-economic level involving methods of mathematical modeling. Papers [2 and 3] have proposed a technique to make optimum decision as for electric equipment operation under the conditions of noisy power. The technique relies upon economic evaluation of various alternatives to recover supply voltage up to the preset quality indices. Moreover, its suitability has been demonstrated in terms of induction motor operation. According to the technique, power indices of electromechanical transducer are calculated involving the current quality power indices within the enterprise power grid [4], and basing upon electric model, and thermal model. If indices, calculated in such a way, differ substantially from preset ones, various alternatives of engineering solutions, intended to recover electric power supplying the motor, are considered. Cost of each of the alternatives is estimated and final decision, concerning its further operation, is made.

Method relies upon the use of power and economic model of certain electric equipment; taken as a whole, it helps optimize selection of technical means aimed at electric energy quality recovery according to cost criterion involving restrictions to power indices of the electrical consumer. However, calculation of different variants is based upon the knowledge of statistic regularities of linear voltage change under specific operation conditions of the equipment. That supposes carrying out of a number of expensive and long-term experiments using real object. To reduce both cost of the experiments as well as their period, it has been proposed to substitute industrial experiments for computational ones. For that purpose, power and economic model is supplemented by a unit to form linear voltages and to control them.

References

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