Abstracts of MMA2016, June 1–4, 2016, Tartu, Estonia

ON ECONOMIC-TECHNOLOGICAL OPTIMIZATION OF HIGH-POWER ELECTRIC CABLES

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High power electrical lines make an important part of all structure for electrical energy supply systems. During construction of such lines two factors essentially influence the selection of optimal sizes of cable. The first one is technological, it should guarantee that during exploitation the maximal temperature of cables is not exceeding some prescribed value. The second factor is economical and attention to it arisen only recently [2, 3]. It is well known that cables have resistance and therefore energy is lost in the electricity supply systems. The amount of generated heat is inversely proportional to the size of a cross-section of the cable. At the same time the total cost of electrical cable system depend on the sizes of cables. Thus the optimal balance must be obtained in order to minimize the cost and satisfy all technological requirements.

The first investigation on optimal sizes of cables, when economical requirements are also included into the total cost was done in [2]. In this report a simple mathematical model is used to calculate the energy losses in electrical cables and it is shown by analytical calculations that optimal sizes of cables should be increased in comparison with sizes defined by the international technical standards. Similar problems are investigated in [3].

In this presentation we investigate much more accurate mathematical models, that take into account all basic factors of heat conduction in electrical cables. Numerical simulation of heat transfer in and around cables is done by using a special numerical solvers, developed to solve heat conduction problems for multiphysics models. Finite Volume Method (FVM) is used to approximate systems of differential equations and OpenFOAM (Open source Field Operation And Manipulation) tool is used to implement the obtained finite volume schemes [5]. This approach enabled us to investigate different cases of nonstationary load dynamics and to estimate influence of day, month and years periodical regimes. Optimal sizes of cables are obtained by applying numerical algorithms targeted to solve PDE-constrained optimization problems.

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