Hierarchical principles of models formation and modelling of electric power systems modes

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Abstract - **The description of construction of a double-lever programm control complex is given. New approaches to a complex problem solving of a state estimation and optimisation of regimes in the conditions of incompleteness and low accuracy of the arriving information are shown.**

Key words - **hierarchical control complex, state evaluation, optimization mode, power pool.**

INTRODUCTION

The integrated power system of Ukraine (IPS) is constructed by a hierarchic principle and contains three basic levels: the National power company (NPC "Ukrenergo"), electric power systems (EPS) and the main network systems (NS) with separate power pool (PP). The modern system of automated dispatcher management (ASDM) of integrated power system of Ukraine is directed to solution of the tasks at the level of supervisory services of NPC and does not provide possibility of efficient co-operation at solution of ASDM tasks at lower levels, first of all, at EPS level. Introduction of the proposed hierarchical operating control complex (HOCC) permits to remove this failing.

HIERARCHICAL CONTROL COMPLEX

The proposed complex ASDM IPS of Ukraine, EPS and PP is intended for a complex solution of the tasks of operatively computation and optimization of current modes, including operation in conditions of incompleteness and low exactness of the initial information. The hierarchical control complex is created as an integrated hierarchical distributed man-machine system on a single information basis with a compatible graphic and tabular multi-window interface. Possibility of operation with graphic images of EPS circuits and primary commutations of PP is used in the complex that permits to analyze the results simultaneously at all levels of hierarchy.

The basic tasks of hierarchical control complex are the tasks of state evaluation of integrated power system, optimization by active and reactive power.

THE TASK OF THE STATE EVALUATION

The task of operative computation of the steady-state mode (evaluation of the state) of EPS by the data of telemetry is the basic part of hierarchical control complex. As a result of its solution an information model of a current or the retrospective steady state is formed. Possibility of this task solution depends on EPS (network systems) observability provision.

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The basic problem of the models forming at a lower level is that it is difficult to provide an adequate presentation of an external surrounding for each of EPS. This problem is solved by means of integration of the own circuit models (without external power systems) with the model of the upper level (NPC). It is difficult enough to support models with large-scale detailed elaboration of an object at the upper level. There is some optimum volume of design circuit which are expedient to be accompanied at one level of hierarchy.

The basic program of the state evaluation is taken as the basis for creation of the hierarchic system. It solves the following sub-goals: synthesis of a design circuit; verification of a mode observability; screening of blunders in measurements. The estimated mode is determined in the result of a criterion function minimization (1):

$$F = \Sigma \sum_{i=1}^{n} R_i \left[\overline{Z}_i - Z_i(\dot{U})\right]^2 \qquad (1)$$

where R_i is a weighting factor taking into account exactness of i- th measurement; $\overline{Z}_i$ is a value of i-th measurement; $Z_i(\dot{U})$ is a design value corresponding to i-th measurement (the function from independent parameters – modules and phases of nodes voltage).

OPTIMIZATION OF ELECTRIC POWER SYSTEMS MODES

For optimization of EPS modes is used the method is directed toward implementation of optimization computations in conditions of a liberal market which supposes electric power prices evaluation for suppliers and users on the basis of demand and supply taking into account network limitations and cost of transport (electric power losses). The basis of the method includes the basic market conceptions of demand and supply equilibrium, and also equilibrium prices. The feature of the described method is that optimization of the power mode is executed simultaneously with computation of the electric one. The purpose of the task solution is maximization of the function of the market functioning efficiency. The system of limitations of the task is made by balance equations of active and reactive power in the equivalent circuit nodes, and also streams by the groups of lines (sections).

CONCLUSIONS

Introduction of the developed HOCC rise on qualitatively new level the decision of problems of operating control EPS and IPS Ukraine both in normal, and in to - and post emergency modes, reduces electric power losses in a network and rise accuracy of technological planning of modes.