Chapter 1

Coordinated Intelligent Operation and Emergency Control of Electric Power Systems

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ABSTRACT

This chapter presents the following approaches and developments: (1) the approach to power system state estimation based on structural and functional decomposition. PMU measurements are used to coordinate the solutions obtained in individual areas; (2) a non-iterative method to calculate voltage

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INTRODUCTION

Last decade’s electric power industry is being liberalized and restructured in many countries. This process forces governments and science to learn what market structures are the most efficient and how regulation methods influence the industry and welfare of the people. Consumers are interested in optimizing their activity in a new environment and investors tend to accurately forecast the prospects of companies in electric power industry and related industries. The growing interest in this field generates necessity to exchange ideas and research results.

The trends in expansion of electric power systems and changes in the conditions of their operation have led to complicate power system operation, increased its changeability and unpredictability that call for prompter and more adequate response of controls systems.

Operational management deals with emergency state prediction concept (probability of emergency state occurrence). Prediction functions can be realized by means of different advice-giver software. But anyway, the final decision (control action) is realized by a system operator who for a variety of reasons is not able to realize rapid and economically ineffective control actions that would prevent an accident development. In such a manner, emergency control schemes do not predict the possible development of the normal, emergency or postemergency states but operate only when the disturbance has occurred.

It is possible to suppose that there are two main disadvantages of the existing control ideology. First disadvantage is the absence of fast control actions realization in operational management. And the second one is the absence of prediction procedures in emergency control.

According to the authors’ opinion, these disadvantages may have been one of the causes of the blackouts that took place all over the world over the last several decades. Describing the disadvantages authors suggest a possible ways of developing and improving of the existent control systems (Panasetsky, 2009).

The main idea is that the new methods that deal with voltage instability and cascade line tripping must complement and do not contradict to the existing ideology. The new control system can be built by using distributed intelligence principles. The distributed intelligence is taken to mean the multi-agent systems.

Development of systems and devices for monitoring the state of energy and electrical equipment (devices and systems of diagnostics) and also monitoring the Electric Power System (EPS) operation conditions seems to be highly important because of radically changed development trends and complicated operating conditions of large-scale Interconnected Power Systems (IPSs) (Kurbatsky, 2009; Voropai, 2010).

Modern systems for measurement of power system state variables and their control, new communication and information processing systems, etc. allow creation on a new basis and with essentially higher efficiency one of the most important stages of power system control – their operation and emergency control.

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