Maintenance Scheduling of Electric Generation Equipment in a Market Environment with Regard to Reliability

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Abstract

The paper suggests an approach to solution of the problem of annual generation equipment maintenance scheduling in electric power systems (EPS). A new statement of the problem and a mathematical model of its solution are given taking into consideration the specific features of deregulated EPS operation as well as conditions for operation and maintenance of energy equipment in a market environment.

Introduction of market mechanisms in the process of management of EPS, including maintenance management results in emergence of independent participants of the market and in a considerable change of the management goals − from minimization of costs in the industry to maximization of profit for the market participants and from maximum possible or normative reliability level to the required one. Liberalization of electric power industry, creation of a competitive electricity market supposes changes in the system of rendering the maintenance services, which creates absolutely new conditions for interaction of generation and maintenance companies.

The choice of criteria to optimize the schedule of generation equipment maintenance in electric power systems that operate in a market environment is determined first of all by the interests of equipment owners and electricity consumers who consider the economic criteria to be the most important ones − maximum profit or minimum electricity price, respectively. The interests of system operator suppose the maintenance schedule optimization on the basis of reliability criteria. These can be the criteria of required level of power supply reliability [1], the capacity reserve or reliability risk equal during the whole maintenance period [2-4] etc. In a market environment disregarding the criterion chosen, there should be a mechanism that will make it possible to coordinate the interests of all market participants when choosing the maintenance periods.

In the present paper the maintenance schedule optimization is based on the criterion of the maximum profit of generation companies (GC). The component of the generation company's penalty charges for breach of the contract on delivery of electric energy, operating and reserve capacity to the network of electricity market due to generation equipment maintenance is entered into the objective function of the problem. This allows one to coordinate the interests of generation companies with one another and with electricity consumers when optimizing the maintenance periods. The combination of two strategies (preventive maintenance and on-condition repair) is used to make up a maintenance list. Introduction of constraints on the size of the maintenance capacity reserve and capacity of maintenance companies enables the requirements for reliability of power supply to consumers and capacities of maintenance companies to be taken into account. The size of the maintenance capacity reserve required for replacement of the equipment capacity removed from service for maintenance without reliability loss is determined by solving the system problem that was formulated in [5].

References

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