Decentralized And Simultaneous Generation and Transmission Expansion Planning Through Cooperative Game Theory

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Abstract: In the new paradigm, electric power system development should provide a negotiation space mechanism between all players with the objective function to maximize payoff distributed to each player in the system. Uncertainty risk and operate effectively and efficiently become a high consideration for all players in the decision making processes to select an investment and power system operation. This paper deals with simultaneous and desentralized with multiple objectives scenario within a global framework. The planning mechanism is prepared on the basis of cooperative game theory. Its coperative framework will encouraged an independently, distributed decision making in the competitive structure environtment. Main contributions of this paper are: a general model for power system planning in the form of cooperative game theory, and its time and spatial decomposition. This method will be implemented in Garver test system.

Index Terms: power system planning, game theory, Shapley bilateral, coalition formation, static security

1. Introduction

Decentralized policy of natural resources management, existing disparity of electric demand in sector classification and in regional level, also the needs for unbundling vertically integrated electric power business stimulate and modify significantly the process and mechanism in power system planning and development. Traditionally, electric power system planning was conducted as a centralized planning with the objective function to minimize investment and operation cost in a framework of welfare maximization for an established reliability services. In line with the restructuring of power industry, some research works have appeared on power system planning on the basis of competitive structure. Due to the the complexity of the problem itself, and some ambiguities in the policies regarding relationship between long-term planning horizon and day by day operations of deregulated power system, the models developed so far are not yet able to compatible to the needs of planners and policy-makers.

In the new paradigm, electric power system development should provide a negotiation space mechanism between all players with the objective function to maximize payoff distributed to each player in the system. Uncertainty risk and operate effectively and efficiently become a high consideration for all players, including independent power producers, transmission owners, independent system operators and consumers in the decision making to select an investment and power system operation. Consequently, power system planning deals with a decentralized planning with multiple objectives scenario within a global framework, and its planning mechanism should be able to evolve adaptively on a number of planning horizons.

There have been a few research works on simultaneous generation and transmission expansion planning. Initial work conducted by incorporating the costs of generation and transmission facilities in a single objective formulation, that minimize total investment cost. A transportation models has been used to represent transmission existing network and its candidate expansion planning.