

A Structural Design of Regional Virtual Power Plant Specific to Industrial Development Area

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Abstract

Compared to the concepts of Micro Grid and Active Power Distribution Network, Virtual Power Plant (VPP) focuses more on top-level designing of an organic combination of distributed energy resources, such as distribution generation units, energy storage devices, adjustable loads, electric vehicle, etc., utilizing information & communication technologies and various control methods. The ultimate objective of VPP operation is to keep the local power system running in the most economical mode.

This article takes a certain development area in mainland China as the analytic target, and proposes a novel structural design scheme for the regional virtual power plant. The scheme sets up a centralized comprehensive operation management platform as the control center of VPP, which brings distributed photovoltaic power units, layered energy storage system, electric vehicle charging facilities and heat & cold supply station into regulation range. Inside the area, on the principle of automatic demand response, energy resources is transmitted and delivered to users in the order of different priority levels. Outside, meanwhile, VPP is connected to the large grid and peripheral tangible power plant, providing auxiliary services like peak load shifting and primary frequency regulation on the premise of regional power sufficiency and stability. Furthermore, based on the cloud trade platform provided by the VPP control center, users inside can balance the redundant generated energy and insufficient power storage between neighbors by P2P electricity transaction at a reasonable price, which improves the utilization efficiency of renewable energy. Lastly, an overall economic analysis is carried out. The analysis results show that under some certain conditions, this design scheme shows financial feasibility. In addition, positive social effects brought by the resource-saving and environment-friendly VPP operation mode is beneficial for the transformation of regional economic development pattern, and demonstrates favorable application prospect and promotional value.