Research on the Power Utilization Strategy of Smart Power Community Integrated with Micro-grid System

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Abstract—This paper presents the key technology used in smart power community with an introduction into the background, concept and characteristics of smart power community. The modeling and simulation of micro-grid system are conducted to identify the proper control strategy to reach its ideal state. Then the load of smart power community is classified and efficient power utilization strategy is proposed.

Keywords-Smart power community; smart power; micro-grid; power utilization strategy

I. INTRODUCTION

In the 21st century, it is universally acknowledged that the development of low carbon economy and ecological civilization should be achieved so as to ensure healthy and sustainable development. The concept of smart power grid has gradually taken shape as a result of great efforts devoted to research and development by experts from home and abroad in the power sector. Nowadays, the smart power grid has been recognized as the key solution to global energy challenge. The construction of smart power community, an essential part of power consumption intellectualization, is a comprehensive project of putting the smart power grid into practical use. The expansion of smart power community will bring benefits to the power division as well as residents [1].

II. INTRODUCTION TO SMART POWER GRID

Smart power can also be called smart power service [2]. The use of smart power technology including advanced metering, efficient control, high speed communication and fast power storage can help respond fast to the market demand, achieve accurate measurement, realize real-time data collection, create various charging methods, provide efficient and convenient service as well as establish a new-type relationship power supply and demand in which a real-time interaction of power flow, information flow and business flow between smart power supply companies and power consumers can be achieved on the basis of modern management and stable power grid.

![Fig. 1. A New-type Relationship of Power Supply and Demand](image)

Smart power community [3] is an interdisciplinary and multi-system application with a combination of computer technology, cabling technology, communication technology, control technology and metering technology. Smart power community is established on the basis of various advanced inventions including user information collection, two-way interaction service, intelligent residential system, distributed power supply and power storage on consumer side and charging technology of electric vehicles. The application of smart power can strengthen the interaction between power consumers and power supply companies and make it more convenient for power consumers to enjoy power services so as to advance the research and development of alternative energy and increase power consumption.

With the inspiration of price incentive mechanisms like time-of-use power price and real-time power price, the use of smart meters, smart plugs, intelligent interaction terminal are promoted, which can further enrich the power utilization strategy [4].

III. THE TYPICAL STRUCTURE OF MICRO-GRID AND ITS IDEAL STATE

The typical structure of micro-grid is presented in figure 2.
The micro-grid is connected to the main power grid by isolation transformer and static switch [5]. The micro-grid is comprised of three feeder lines: A, B and C. Feeder line A and B are connected to sensitive load and non-essential load. Different loads pose different requirements to the power supply system, therefore micro power source is located in different parts of feeder lines based on different rules, which can increase energy efficiency of micro power source and maintain its power stability as the power generated by the micro power source can be consumed as soon as possible. Feeder line C is connected to non-essential load without micro power source and powered by the grid. Each outlet of micro power source is equipped with breaker, power controller and voltage controller so that power output can be adjusted to change the current distribution of feeder lines under the control of energy management system. The Switch S would be isolated when power quality problems like voltage disturbance or power failure of the main grid are monitored. The micro-grid will be in island operation isolated from the main grid to ensure uninterrupted power supply of key sensitive load. At the same time, the power output of each micro power source would be changed under the control of power management system to ensure the proper functioning of the micro-grid. The non-essential load of feeder line A, B and C would be lowered in power supply or even cut off from power supply to reach the power balance of micro-grid.

The Micro-grid is in parallel operation with the main grid under normal conditions. When the external power grid breaks down and voltage loss on parallel bus is detected, the bi-lateral inverter (power storage inverter/ DC-AC inverter) would be switched to the mode of constant voltage/ constant frequency as required and operate independently on load. When the external power grid is in proper functioning with normal voltage detected by the mode controller, the power grid would operate on load with storage battery inverter cut off. Then storage battery would switch to charging status. The flowchart can be seen in figure 3.

**IV. MODELING AND SIMULATION ANALYSIS OF MICRO-GRID**

In this thesis, a simple model of the micro-grid is presented in figure 4. As shown in the Figure 4, the main grid and breaker are marked. Load 1 and load 2 being sensitive loads with other loads being non-essential loads and DG being distributed generation module.
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