Preface

With the rapid development of electric vehicles (EVs) as well as the promotion and application of vehicle-to-grid (V2G) technologies, EVs charging loads, as flexible loads, have the potential to participate in the grid services, including peak shaving and valley filling, frequency regulation (FR), emergency power, energy market participation, and so on. Therefore, great attention has been paid to EVs and V2G.

Focusing on the interactions between EVs and power system, this book aims to bring readers with basic knowledge of electrical engineering promptly to the frontier of the EVs' influence on power system and environment. This book may serve as a reference for scientists, electrical engineers, and postgraduate students majoring in electrical engineering or other related fields.

Outline of the Book

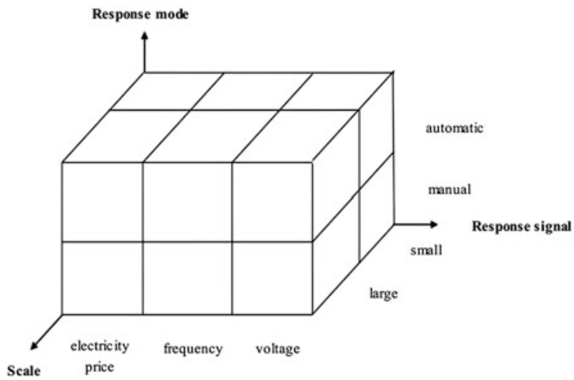
This book discusses electrical vehicles integration into power system on three aspects as follows.

In Chap. 1, the influence of EVs on power system through improving urban microclimate and its consequent effects of energy conservation and emission reduction are revealed.

In Chaps. 2–5, V2G technologies are elaborated. In our opinion, V2G technologies can be classified from different perspectives, as depicted in Fig. 1. In terms of the scale of charging stations, it can be divided into large and small scale; in terms of the response signals, it can be divided into electricity price, frequency and voltage; and in terms of the response mode, it can be divided into manual and automatic response.

In Chaps. 6 and 7, planning of EV charging facilities are discussed. Based on the reverse discharge capacity of EVs, advantages, disadvantages, and adaptive range of several typical schemes of the integration of charging facilities into the grid are

Fig. 1 Structure of V2G



explored, and a method of dividing EV charging facilities planning into different stages based on V2G is proposed.

The contents of each chapter are shown below.

In Chap. 1, the influence of EVs on power system through improving microclimate is elaborated. This chapter studies the interactions between urban microclimate and air-conditioner load in power system and the influence of large-scale EVs' integration into the grid on urban microclimate, and analyzes the indirect influence on power system and its consequent indirect energy-saving effects. This chapter is written by Prof. Canbing Li.

In Chap. 2, the response of EV charging load to time-of-use (TOU) power price is analyzed. Based on the existing research and the state of charge (SOC) curve, an optimized charging model for the regulated market is proposed in this chapter. By using the proposed method, EVs are able to reduce the cost of customers by adjusting charging power and time, thus achieving peak shaving in load demand. This chapter is written by Prof. Yijia Cao.

In Chap. 3, the response of EV charging loads to the grid voltage is analyzed, and a control strategy is proposed. In the proposed strategy, the alternate current (AC) side voltage of electric vehicle charging stations (EVCSs) is selected as the voltage signal and the EV user experience is taken into account. The response priority of EVs is updated real-timely to avoid any EV participating in under-voltage load shedding (UVLS) for a long time. The simulation results show that EVs can help the grid voltage recover to an allowable range and EVs participating in UVLS can be fully charged within the time set by EV users. This chapter is written by Dr. Bin Zhou.

In Chap. 4, a coordinated control strategy for large-scale EVs, battery energy storage stations (BESSs), and traditional FR resources involved in automatic generation control (AGC) is presented. Response priorities and control strategies for the FR resources vary with different operating states. The simulation results show that the proposed method can not only fully utilize the advantages of EVs/BESSs, but also achieve the coordination among different FR resources, thus improving the frequency stability. This chapter is written by Ms. Yonghong Kuang and Prof. Canbing Li.

In Chap. 5, an asynchronous control method for small-scale dispersed charging EVs to participate in FR is proposed. The results of simulations under different disturbances demonstrate that the gradual participation of EVs in FR can effectively alleviate the frequency deviations and avoid overshoot. This chapter is written by Ms. Yonghong Kuang.

In Chap. 6, three typical schemes of the integration of charging facilities into grid, including electric vehicle charging stations (EVCSs) directly integrated into or adjacent to 110 kV substations, EVCSs integrated into the tie point of looped distribution grid, and the parallel operation of special load with EVCSs, are explored. Furthermore, the advantages, disadvantages, and adaptive range of the above three typical schemes are demonstrated. This chapter is written by Dr. Bin Zhou and Prof. Canbing Li.

In Chap. 7, the EV charging facility planning is explored. Based on V2G, the planning is divided into three stages: demonstration stage, public service stage, and commercial operation stage. Characteristics of each stage are analyzed and the charging demand of each charging method is predicted based on the optimized model of charging methods put forward in this chapter. Results of the case studies reveal the applicability of this planning method. This chapter is written by Dr. Bin Zhou and Prof. Canbing Li.

In surveying this book, readers can obtain information about the interactions between EVs and power systems based on V2G. Although some work on EVs and power systems has been done in this book, there is still plenty of space for development in theory and applications.

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