Chapter 6
Advanced Models and Simulation Tools to Address the Impacts of Electric Vehicles in the Power System (Steady State and Dynamic Behavior)

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Abstract

The foreseen deployment of Electric Vehicles (EV) will considerably affect the way power systems will be managed and operated. The extra amount of power they will demand from the grid will oblige transmission and distribution system operators to understand the impacts resulting from EV connection into electricity networks. In this sense, a set of models and simulation tools to address the impacts of EV in the power system is presented in this chapter. Specific models and tools are presented for both steady state and dynamic behavior studies. Concerning the steady state, two tools are presented, one dedicated to the identification of EV integration limits and the other capable of performing a spatial-temporal EV movement simulation, both for distribution grids. Two more simulation tools are presented for the dynamic behavior studies, one for evaluating the EV capability to participate in primary frequency control and the other for assessing the benefits of integrating EV in the automatic generation control operation. In addition, a description of the framework required to enable EV controllability is also provided.

6.1 Introduction

This chapter is intended to identify grid operational management and control strategies that should be available to deal with a large scale deployment of Electric plug-in Vehicles (EV). EV are high flexible loads which can be used as mobile storage devices, thus being capable of providing several power system services, [1]. In fact, EV batteries when in charging mode can behave as controllable loads, providing spinning reserves as a result of a load decrease or even providing power back to the grid under the so-called Vehicle-to-Grid (V2G) mode, helping peak