Project: NPRP8-241-2-095 (Award Active)
Title: Integration of Solar Generation and Electrical Vehicles into the Smart Grid
Duration: 3 Year(s)
Start Date: 2/1/2016 12:00:00 AM
Submitting Institution: Texas A&M University at Qatar
Research Area: 2. Engineering and Technology
Speciality: 2.02 Electrical, Electronic, and Information Engineering
Sub Speciality: Automation and Control Systems
Project Description:

Countries in the Middle East have an abundance of solar energy resources, and also have emerging issues with tail-pipe pollution from growing number of personal vehicles. The use of photovoltaic (PV) generation and electrical vehicles (EVs) seems to be a natural choice for managing carbon footprint. This project aims at investigating the potential benefit from integration of Electrical vehicles (EVs) and photovoltaic (solar) generation into smart grid. The optimal method studied in this project is to coordinate EVs battery storage and solar generation to help improve the electric grid performance, which will also be quantified. The result of the project will not only benefit the placement of EV charging stations to better utilize the electric grid resources, but will also benefit the power grid operation and pave the road for future integration of smart grid flexible load technology. The project will focus on three issues: a) integration of photovoltaic (PV) generation and EV charging stations through DC or AC bus, b) interfacing the DC or AC bus to the power system using advanced power electronics, and c) analysis of the impacts of the PVs and EVs on the power grid operation. The integration and interfacing will be optimized to support several utility applications: demand side management, outage management and asset management. The EV operation will be viewed in two modes: grid-to-vehicle (G2V) and vehicle-to-building (V2B). The impacts on the grid will be analyzed under both modes of EV operation. The demand side management analysis will include impacts of the flexible load that has storage (EVs) and and PVs connected to it. The typical scenario is when EVs are parked next to a building that also has PV generation accessible for the use by EVs. In this arrangement, impact of EVs and PV generation will mainly focus on supporting the grid with reactive power compensation, peak load shaving, load shifting, and reducing annual energy cost. The outage management will investigate how distributed PV generation and EV battery storage may be used to support the load, and in turn the electricity grid during loss of power. Also, the impact of the loss power on the ability to fully charge EVs and the support of PV generation in this context will be studied. The asset management problem will primarily focus on the role of EVs and PV generation in managing existing utility assets. The impact on the utility equipment overloading due to EV charging, and the support PV generation can provide to alleviate such overloads will be studied. The key project contribution is the study of different modes of interfacing and integrating the EVs and PVs into the grid. Each mode of interaction of EVs and PVs with the electricity grid will represent several options on how the smart grid may be expanded to include EVs charging stations and PV generation at the customer sites. Economic benefits and technical challenges will be elaborated and quantified.

Project Key Investigator(s):

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