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Impact of Charging PHEV at Different Penetration Levels on Power System Network

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Abstract : Plug-in Hybrid-Electric Vehicle (PHEV) has gained immense popularity in recent years. PHEV offers numerous advantages compared to the conventional internal-combustion engine (ICE) vehicle. Millions of PHEVs are estimated to be on the road in the USA by 2020. Uncoordinated PHEV charging is believed to cause severe impacts to the power grid; i.e. feeders, lines and transformers overload and voltage drop. Nevertheless, improper PHEV data model used in such studies may cause the findings of their works is in appropriated. Although smart charging is more attractive to researchers in recent years, its implementation is not yet attainable on the street due to its requirement for physical infrastructure readiness and technology advancement. As the first step, it is finest to study the impact of charging PHEV based on real vehicle travel data from National Household Travel Survey (NHTS) and at present charging rate. Due to the lack of charging station on the street at the moment, charging PHEV at home is the best option and has been considered in this work. This paper proposed a technique that comprehensively presents the impact of charging PHEV on power system networks considering huge numbers of PHEV samples with its traveling data pattern. Vehicles Charging Load Profile (VCLP) is developed and implemented in IEEE 30-bus test system that represents a portion of American Electric Power System (Midwestern US). Normalization technique is used to correspond to real time loads at all buses. Results from the study indicated that charging PHEV using opportunity charging will have significant impacts on power system networks, especially whereas bigger battery capacity (kWh) is used as well as for higher penetration level.

Keywords : plug-in hybrid electric vehicle, transportation electrification, impact of charging PHEV, electricity demand profile, load profile
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