Determination of Maximum EV Penetration Level in Residential Distribution Network

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Abstract. In order to accommodate Electric vehicles (EVs) charging demand which is expected to rise steeply in the coming years due to environmental concerns on global warming, it is important to determine the maximum EV penetration can be allowed without network upgrading and avoid overloading of Medium Voltage (MV) cables and distribution transformers in residential distribution power systems. In this contribution, a methodology is proposed to model the EV penetration and their effects on operational temperature of MV cables and transformers, with charging scenarios and harmonic currents taken into consideration. The method is simulated in a typical urban residential distribution system. The results show that EV penetration above 27.25 % with 6.6 kW EV chargers charging in uncontrolled domestic scenario will lead to 10 kV distribution cables overloading in the simulation with harmonic current taken into consideration. The result is 30.74 % if harmonic currents are ignored. The maximum allowable EV penetration of 35/10 kV 16 MVA and 10 kV 1250 kVA transformer is 50.22% and 26.19% respectively. If EVs charge in off-peak time, the cable and transformer can avoid overloading and the charging cost is lower.