Institute of Energy Systems, Energy Efficiency and Energy Economics

SmartGridTecLab Dortmund

M. Sc. Thesis: Practical Development of Charging Strategies for Electric Vehicles

A description of a project for a Master's Thesis at the Institute of Energy Systems, Energy Efficiency and Energy Economics (ie^3), TU Dortmund University.

Background and Motivation of the Thesis

In many areas, public low voltage networks (0.4 kV) are close to congestions due to increasing peak loads. Electric vehicles will introduce a serious increase in these load peaks if the charging is done in an uncoordinated manner. Unlike over voltage, overloading is considered as a "hard" constraint (if voltage constraints are slightly exceeded, no serious consequences occur). If the current capacity of the network is exceeded, a fuse will burn immediately at the secondary substation and cause a power outage in the whole low voltage network. That is why overloading network must be avoided and considered when introducing electric vehicles.

The topic is extremely relevant and interesting in the power distribution as well as to the automotive industry across Europe. It is also in line with the political decisions of the European Union to increase electric mobility.

Tentative Work Plan

The main objective of the thesis is to develop new strategies to charge electric vehicles so that the possible risk of overloading any network component is taken into account. The precise work plan is fixed with the student before the start of the project. The work will be done at the Smart Grid Technology Lab. The work is continuation to an already finished MSc Thesis entitled "Real-Time Voltage and Thermal Management of Low Voltage Distribution Networks through Plug-In Electric Vehicles".

1) A short biographical search about the existing methods is carried out. Introduction to the work of the previous MSc Thesis.

2) Modification and further development of selected charging strategies.

3) The developed strategies will be tested and demonstrated in a low voltage network through hardware-in-the-loop simulations (Simulink/dSPACE or HYPERSIM/OPAL-RT) by using real electric vehicles and charging stations.

4) Transfer of the algorithms to a low-cost programmable microprocessor (Arduino, Rasperry-PI, etc.). Implementation of the microprocessor as a part of "intelligent" charging station together with measurement sensors. (*Optional step. Done if enough time is available.*)

Please note: This thesis is strongly focused on practical laboratory work, Step 3) being the most significant part of this thesis.

The Profile of the Student

The thesis is suitable for a student with background in electrical engineering and interest in new smart grid technologies, electric mobility and algorithms. The practical nature of the thesis guarantees that the student gains significant hands-on experience. The theme is open to several possibilities and can be modified to match the wishes and the requirements of the student. The thesis is encouraged (but it is not obligatory) to be written in English.

Supervision

The work is supervised by Kalle Rauma.

Further information

Please contact Kalle Rauma (kalle.rauma@tu-dortmund.de) for additional information.
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