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ECXX_LABYY_NOMChercheur_Numer

ECXX = ECLi, ECL, ECM, ECN, CS

LABYY = acronyme du laboratoire

NOMChercheur = nom du chercheur émetteur du sujet

Numer = numéro de la proposition (01, 02,) pour le chercheur

PhD Proposal 2017

School: CentraleSupélec	
Laboratory: Group of electrical engineering of Paris (GeePs)	Web site: http://www.geeps.centralesupelec.fr/
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Collaboration with other partner during this PhD:	
In France: EDF R&D	In China:

Title: Modelling and management system tools for active low voltage distribution networks
Scientific field: Electrical Engineering
Key words: low voltage distribution networks, modelling, state estimator, load flow

Details for the subject:

(Maximal length of 2 pages, including images, list of reference, ...The pdf file should not exceed 1Mo)

Background, Context:

Nowadays, the low voltage distribution networks (400V of rated voltage in France) become more and more active with the connection of distributed generators (e.g. wind turbines, solar panels, etc.) and the arrival of flexible loads (e.g. electric vehicles, storage systems, etc.). However, these new elements, often single-phase and intermittent, impose significant technical constraints, which the Distribution System Operators (DSOs) should cope with: voltage unbalance, voltage fluctuations, low/high voltage profile, elevated neutral-to-earth voltage... To manage optimally those constraints, precise and reliable management system tools (i.e. state estimator, load flow) will be needed. In turn, an accurate model of the networks will be required for the operation of these management tools.

Research subject, work plan:

This PhD project comes within the scope of the research topics on Smart Grids of the RISEGRID institute, which was cofounded by CentraleSupélec and EDF R&D. The project has two-fold objective:

- Firstly, the active low voltage (LV) distribution networks, with the network components (i.e. lines, cables, transformers, distributed generators (DGs), flexible loads) will be characterized and modelled. In particular, it should bear in mind that three-phase LV lines/cables consist of four wires: three phase-conductors and a neutral conductor that is regularly grounded. The latter, which is generally hidden with the Kron's reduction, does not explicitly appear in network analyses. This simplification will reduce the model accuracy. In addition, the impact of grounding connectors is rarely taken into account. Those particular points will be addressed during the project.
- Secondly, from the proposed network model, the LV network management tools will subsequently be developed: three-phase four-wire load flow program and state estimator, which will be used for network monitoring, congestion and power quality management in presence of flexible loads and of DGs.

The research will be carried out as follows:

1. Literature review of modelling techniques for three-phase four-wire LV distribution networks; including earth connectors, DGs and flexible loads.
2. Development of a novel modelling technique: validation with simulations on EMTP-RV and laboratory experiments.
3. Development of load flow program and state estimator for three-phase four-wire LV distribution networks; validation of results with EMTP-RV.
4. Application of developed management tools on IEEE test networks: monitoring of LV networks with presence of flexible loads and DGs; power quality analyses: unbalance, voltage profile, elevated neutral potential...Optimization of production/consumption of DGs and flexible loads to cope with the network constraints.

References:

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