

Master Project Proposal, 2023-2024

— Study and analysis of the interaction between transmission and distribution grids —

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Internship Location: Junia - Lille

Context

. This work is funded by RTE, France's Transmission System Operator (TSO), (<https://www.rte-france.com/>) and GEREDIS, Distribution System Operator (DSO) of Deux Sèvres departments (<https://www.geredis.fr/>). The massive penetration of DER (Distributed Energy Resources) in the distribution grid leads several challenges for both transmission and distribution networks. The intermittent behavior of DER makes complicated the voltage control and the power flow management through distribution towards transmission grid. Hence, a reliable coordination between both distribution and transmission grid is mandatory to preserve the safety of the electrical network.

Main objectives

- . State of art on the interaction issue between TSO and DSO under full penetration of DER.
- . Assess and investigate the mutual influences between transmission and distribution networks using numerical simulation models (simulation and analysis models).

Work steps and Milestones

.Task #1: State of Art on:

- The physical interface between transmission and distribution grids;
- The mutual impact between transmission and distribution grids in the presence of Renewable energy sources ;
- The possible degrees of flexibility through the integration of DER, which optimizes the coordination between TSO and DSO.

. Task #2: Interaction analysis between transmission and distribution grids

- Elaboration of mathematical models allowing the modelling of physical interface between transmission and distribution grid. The modelling perimeter should be identified and justified.
- The types of models as well as the simulation environments will be discussed (load flow model, EMT model,).
- Development of detailed simulation models under Power-Factory or/and MATLAB-Simulink covering the HV and MV networks. The integration of DER will be modelled and simulated also.
- Based on the last model, the aim is to reproduce and analysis the interactions phenomena identified in literature review.
- Achievement of analysis models (simplified and average models) under MATLAB environment, addressing the possible flexibility levers by integrating DER. After the validation, these models will be performed to analysis in-depth the flexibility levers supplied to the grid under several operating conditions.

Keywords

Distribution network, Transmission network, Network flexibility, Power and Voltage management

Preference in candidate profile

The candidate should already have at least a minimum level of French (speaking, listening, reading and writing skills)

References

Chen-Ching Liu, Emma M. Stewart, Electricity Transmission System Research and Development: Distribution Integrated with Transmission Operations, April 2021, Transmission Innovation Symposium: Modernizing the U.S. Electric Grid 2021 White Papers, Prepared for the Office of Electricity U.S. Department of Energy, <https://www.energy.gov/>.

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Jain, H.; Bhatti, B.A.; Wu, T.; Mather, B.; Broadwater, R., Integrated Transmission-and-Distribution System Modeling of Power Systems: State-of-the-Art and Future Research Directions. *Energies* 2021, 14, 12. <https://doi.org/10.3390/en14010012>

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