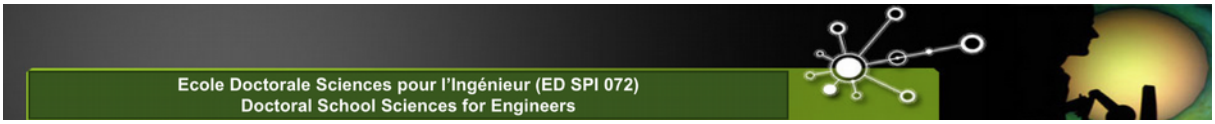

Title : Transmission system restoration based distribution grids with distributed resources

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Co-supervision : F. Colasfrederic.colas@ensam.eu

Funding : research contract with RTE and ENEDIS

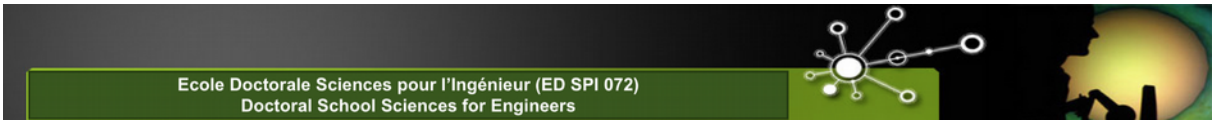
Context

Due to the development of the renewable energy, the general organization of the power system tends to be largely modified. From a very centralized scheme based on large power plants, the grid is evolving to a more decentralized system due to the integration of distributed resources which are connected to the distribution grid. Hence these grids, which used to be considered from the transmission system, as passive tends to be more and more active.
Nowadays, nearly all the variable renewable energy sources (wind turbine, PV) are connected to the grid thanks to power electronic converters. Till now, they are connected as some current injectors (called grid following control) which need to be synchronized on a voltage waveform. In the future, it is expected that some of them could behave as voltage source (grid forming control). As this type of control allows to stay stable even in case of standalone operation, it could be possible to keep the stability of some a distribution grid in case of a black out thanks to these types of converter.
Due to this property, it could be asked to some specific distribution grids to restore a part of a transmission grid in case of a general black out in order to reduce the loss of load duration. This is the main aim of the proposed Phd.

Objective

The phd objectives can be divided into 3 steps:

1. In a first step, the Phd will focus on a distribution grid in standalone situation which would be energized thanks to some grid forming converters. A very large bibliographic study will be developed in order to analyze, on one hand, the papers published in the microgrids area and, on the other hand, the papers published on the transmission grid that includes a large amount of power electronic converters. A stability study dedicated to medium voltage system that includes both grid-forming and grid-following inverters will be addressed.
2. The energization of a second distribution grid will then be considered. A first possibility is to synchronize two grids which are already energized. This supposes to manage the phase difference between both grids in order to minimize the transient current when connecting these grids. A second possibility consists in energizing another distribution grid from a first distribution grid already in operation. In this case, the question of the energization of a transformer and, then, loads with a power electronic converter will be addressed. Indeed, the large inrush current may be drawn when connecting a transformer on a voltage source. It has to be limited when this voltage source is generated by a power electronic converter and some soft-start methods will be evaluated during this step.
3. The synchronization of a large wind farm connected to the transmission grid will be addressed. The management of the active power delivered by this wind farm will be considered in order to maintain the balance between production and consumption in this kind of situation.



Position Requirements

The PhD candidate will be requested to have a MSc with a relevant background in electric power systems or power electronic converters with application in power systems, preferably from a reputable institute from a country within the European Economic Area.

The candidate will send his CV and letter of motivation to phd.position@epmlab.eu