LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

# *Modelling and study of induction regulator to provide reactive power to the grid*

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## Context

In the case of PM synchronous generators used in medium hydro-power plants, the reactive power supplied to the grid cannot be controlled as for the wound rotor synchronous machines. This can be achieved through capacitive banks or power electronic converters. However, the first solution can induce some problems in terms of material aging and then fire risks. The second solution is much safer but it requires a significant cost which limits its interest.

An alternative to these two possibilities consists in using a three-phase induction regulator. The latter is based on the structure of a doubly fed induction machine. When used as a three-phase transformer at locked rotor, the relative position of the latter with respect to the stator leads to different angles between the windings and then to vary the secondary voltages while keeping the same primary ones. In this configuration, this device is already used with the stator windings (secondary of the 3-phase transformer) put in series on the grid. Therefore, their voltages are added to the ones upstream in order to reach the de desired voltage downstream (see figure). This configuration works well but it means that the stator windings should transfer the whole power of the grid and then to be designed to this aim in terms of mass and volume. To avoid this, a possible solution could be its use in parallel on the grid.

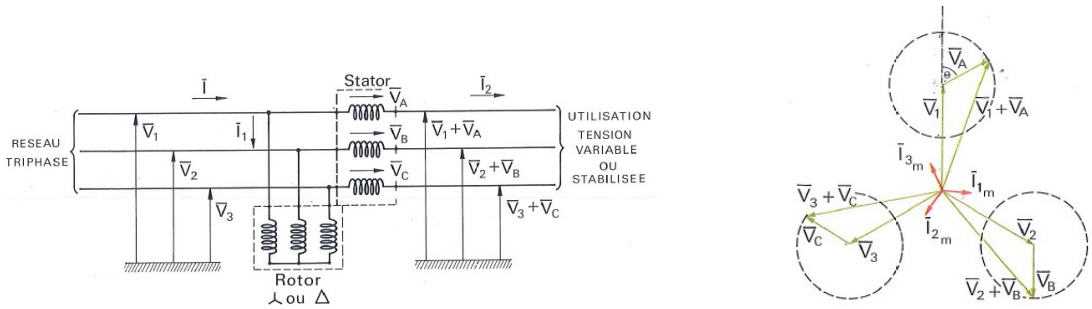


Fig. Three phase induction regulator in series on the grid

## Objectives

The proposed work aims at investigating the use of a three-phase induction regulator put in parallel on the grid. In this case, the secondary will be constituted of two 3-phase windings which will allow a wider range of angles by adopting different coupling combinations and rotor position. Such solution will be of course downsized when compared with the series solution since it will transfer only a part of the active power, thus its interest.

## Progress

The work would proceed as follows:

1- State of the art of the induction regulator in the industry.
2- Built up of an analytical model that allows to determine the angles between the primary and the secondary windings with respects to the coupling and the position of the rotor
3- Design of a prototype of an induction regulator with two 3-phase secondary windings and study of the prototype using numerical modeling based on FEM.
4- Study of the performance of the designed regulator and validation of the results obtained by the analytical model in terms of voltages (magnitude and shift-phase) through the different coupling configurations while taking into account the nonlinear behavior of the magnetic material.

## References

https://studylibfr.com/doc/3142502/--la-houille-blanche