# Analysis and Control of Power Electronic Elements inserted into Modern Power Transmission Grids

**Key words:** modelling of large-scale power systems, power converters, interaction and coordination, HVDC, inter-area oscillations, small-signal/transient stability

**Context:**
Power electronics is more and more used on the power transmission grids. Indeed, all wind and photovoltaic generation is connected to the grid by converters. Also, the reinforcement of the grid is frequently done with High-Voltage Direct Current (HVDC) lines which consist of 2 power converters into a back-to-back connection and a DC cable. This tendency will be extended in future in order to ensure the transition towards decarbonized energy systems as formulated, for example, in Europe.

This new technology based on power electronics is active in the sense that it provides several degrees of freedom for the power and voltage control. Thus, it has an impact on the dynamics of the neighbour AC power system. In particular, the small-signal and the transient stability depend on the way in which the regulators of the converters are synthesized.

**Research subjects:**

- Study of impact of different HVDC control strategies on transient and small-signal stability of the neighbour AC grid
- Analysis of stability of large-scale transmission grids (large-scale eigen-computation and dynamic studies, eigenvalues parametrization and uncertainty quantification, …)
- Modelling of new elements of the grid (renewable and decentralized generation)
- Revisit the protection system with the use of new Wide Area Measurements Systems (WAMS)

**Competences needed:**

The candidate should have background and experience in modelling of power electronics, classic (synchronous) generators and power grids. As the approaches will be in the field of automatic control, knowledge of advanced control techniques (like robust H-infinity or H2 control) would be a serious advantage. The candidate should be at least motivated to involve in these approaches with the help of automatic control collaborators. Another welcome competence is the numerical development/implementation of eigen-computation codes (for stability analysis of large-scale power grids).

**Framework:**
This work is proposed in a general framework of collaboration with RTE – the French Transmission System Operator – and ENTSO-E and it is thus connected to real needs of the interconnected power systems. Realistic tests and validations of the theoretic developments mentioned above should be done on (large-scale) grid models and scenarios provided by RTE and ENTSO-E. The Control of Power Grids chair ( http://chairerte.ec-nantes.fr/ ) which exists between Ecole Centrale Nantes and RTE R&D guarantees the direction and the financial founding of this work. The work will be carried out in Nantes-France.

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