CONSEIL INTERNATIONAL DES GRANDS RESEAUX ELECTRIQUES
INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS

STUDY COMMITTEE D2
INFORMATION SYSTEMS AND TELECOMMUNICATION

http: //d2.cigre.org

2017 Colloquium
September 20 to 22, 2017
Moscow – RUSSIA

Preferential Subject N°PS1

Inverter Control in the Formation of Microgrids

S. MUZALEV
JSC «Technical Inspection UES»
Russian Federation
sergeimuzalev@gmail.com

Microgrid appears as a group of interconnected loads and distributed energy resources with defined electrical boundaries that acts as a single controllable entity and is able to operate in both grid-connected and islanded mode.

Generating sources of microgrids is projected to be predominantly consisted of power-electronics-interconnected units with significant share of energy storage systems (ESS): as stand-alone with individual scheme of power infeed and as a part of generating units, connected at DC-buses. The preceding is argued by performance-based values of some small-to-medium power generating unit's design and necessity to take up load steps in islanded mode.

Microgrid's generating units composition leads to necessity of establishment the concepts of primary and secondary active and reactive power control. The latter appears as trade-off analysis of distinctive automatic control systems used in uninterruptable power supply, where inverters are widely deployed, and within generating units of centralized power supply – droop control – as an alternative, where each possess its own bound technical issues.

It is evident that LV and MV electric grids – distribution and object's inner power supply grids – considerably differ from HV and EHV grids in terms of parametrical and topological characteristics. Chiefly, the latter manifests in highly resistive nature of grid's elements and short electrical distances (low mutual impedances) between generating units connection points, which lead to contradictory in requirements has to be solved. On the one hand, the implementation of conventional P & Q droops does not imply fully decoupled voltage regulation as it is met in HV and EHV grids. On the other hand, even low-amplitude voltage oscillations lead to significant circulating currents.

As a solution of previously described problem, oscillation-limiting purpose-oriented scheme elaboration, normal grid's inductance increase and algorithmical approaches are proposed. Within the confidence of the latter, one-fit-all "virtual impedance" algorithm, providing splitted control of frequency and voltage, units dispatch with regard to their capacities and emulation of virtual synchronous machine, is described.

In the end, the features of secondary power control in the formation of microgrid are revealed, highlighting the not-lasting-long reserves of ESS, appearing here as the main contributor to primary power control.