Contribution ID: **434** Type: **not specified**

P4.098 Tokamak coil operations by energy-conservation converters and distributed energy storage

Thursday, 20 September 2018 11:00 (2 hours)

Tokamak operations requires high-current coils. The systems typically used to supply these coils (self-commutated converters, resistive switching network units) present several drawbacks: high reactive power, harmonics, discontinuous loads, dead times, energy dissipated as heat during breakdown. Some traditional solutions involve large flywheels and power factor compensators. The achievable performances can be optimized by distributing the energy storage (DESS) to each coil and by adopting static devices, as supercapacitors.
The resulting architecture exploits the principle of conservation of energy: the energy in the coil circuit is virtually constant, it is only transformed from an electrostatic to a magnetic form (including the energy exchanged with the coupled coils and with the plasma). Instead of freely oscillating, the energy transfer is managed according to the desired scenario by an energy-conservation converter (ECC). This can be a thyristor or a IGBT/IGCT bridge. In the latter case, the control is faster and suitable also for the breakdown phase.
After the scenario, the energy requested by the coil goes back to the DESS, ready for a new operation. The perfect conservation is impossible and its damping is due to the plasma resistance, the ECC parasitic components, the vessel passive elements, the connections, the supercapacitor nonidealities, while the losses in the coils are negligible in case of superconductors.
The lost energy is restored by the DESS input power supplies. This can be at any value of active and reactive power, depending on the experiment and grid needs, even to implement long operations. A design for 100 s (DTT) will be presented.
Even if the DESS/ECC costs may exceed those of other solutions, they are compensated by the simplification in the distribution system (substation, cable, transformers), by the energy saved at each operation and by the intrinsic advantages in terms of maintainability, modularity and dynamic performances.

Presenter: LAMPASI, Alessandro (ENEA)

Session Classification: P4