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A European design proposal on the ITER ELM-Coil Power Supply optimized for ELM mitigation and RWM stabilization

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The paper describes a design proposal for the ITER ELM Coil Power Supply, optimized for the simultaneous ELM mitigation and RWM stabilisation during the ITER non-inductive operation. Slow (ELM) and fast (RWM) rotating magnetic fields are generated by exciting the three sets of nine ELM-Coils at ELM-frequencies up to 5 Hz (N = 4) and RWM-frequencies up to 60 Hz (N = 1). Starting from a basic concept of the power supply scheme proposed by IO, the EU-DA developed, studied and optimized the power supply and control systems, by means of extensive computer models. By combining the nine DC-AC IGBT Inverter Power Units on the same DC-bus, the AC-DC converter is optimized but substantial current harmonics at frwm ± felm are generated in the DC-system. In turn, these excite low frequency LC-resonance arising from the distributed DC-capacitor banks and stray inductance of DC-power connections. Further cancellation of the current harmonics at the DC-system level is primordial (impact on the grid) and requires an accurate phase control of the nine ELM-Coil currents. The optimized power and control scheme, featuring commercial compact water-cooled IGBT Inverter Assemblies with own DC-bus, achieves very good performance in normal operation (amplitude error < 1%, phase error < 1°), is shown to be immune to power system imbalance and is well protected against plasma disruption through the synchronized triggering of bi-polar thyristor crowbars. The equipment layout and component ratings of the power supply scheme have been completed. In view of the limited space at the level-4 of the Tokamak building, a compact layout was developed, in which the AC-DC Converter and nine DC-AC IGBT Inverter Power Units are assembled on a two-level metallic structure, designed to be lifted complete by the ITER station crane.

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