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Tue-Af-Po2.16-10 [24]: Transient Analysis of AC Power System for JT-60SA Superconducting Magnets

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JT-60SA is the second largest tokamak device constructed in the world, which is being implemented aiming to start the first experiment in 2020. One of the most important features of JT-60SA is to have superconducting magnets for long-pulsed plasma discharge (100 s flattop). JT-60SA has ten of poloidal field (PF) coils for inductive current drive and shape control of a plasma. Their stored magnetic energy is up to 1 GJ in total. The current for each coil is individually supplied by thyristor-based AC/DC converters, which require a large amount of AC power more than 250 MVA. In JT-60SA, all the PF coils are powered by a dedicated motor-generator called H-MG (400 MVA/2.6 GJ). In addition, from the second research phase, some additional plasma heating devices, such as neutral beam injection (NBI), are planned to be connected to the motor-generator in parallel to the AC/DC converters for PF coils.
In the AC power system, one of the key issues is unacceptable voltage distortion. In the case of emergency event such as magnet quench, all the AC/DC converters stop and the magnetic energy is discharged immediately using Quench Protection Circuits (QPCs) to protect the superconducting coils. This protective action leads to large and rapid load change and thus an overvoltage in AC side. In addition, plasma disruption also causes rapid load reduction since NBI must be shutdown to avoid the damage of plasma facing components inside the vacuum vessel. In such a case, however, AC/DC converters should be operated properly for normal demagnetization to suppress AC loses of superconducting magnets.
This presentation focuses on transient analysis using an integrated circuit simulation model and optimization of the AC power system at the emergency events.

Author: Mr HATAKEYAMA, Shoichi (National Institutes for Quantum and Radiological Science and Technology)

Co-authors: Mr SHIMADA, Katsuhiro (National Institutes for Quantum and Radiological Science and Technology); Dr YAMAUCHI, Kunihito (National Institutes for Quantum and Radiological Science and Technology); Mr OKANO, Jun (National Institutes for Quantum and Radiological Science and Technology); Mr OHMORI, Yoshikazu (National Institutes for Quantum and Radiological Science and Technology); Mr TERAKADO, Tsunehisa (National Institutes for Quantum and Radiological Science and Technology); Dr MORIYAMA, Shinichi (National Institutes for Quantum and Radiological Science and Technology)

Presenter: Mr HATAKEYAMA, Shoichi (National Institutes for Quantum and Radiological Science and Technology)

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