DESIGN AND ANALYSIS OF SWITCHING NETWORK UNITS FOR THE ITER COIL POWER SUPPLY SYSTEM

A. Roshal[1], S. Avanesov[1], E. Koktsinskaya[1], M. Manzuk[1], F. Milani[2], G. Mustafa[3], A. Nesterenko[1], I. Song[2], A. Filippov[1], A. Frolov[1]

[1] *D.V. Efremov Scientific Research Institute of Electrophysical Apparatus, 196641 St. Petersburg, Russia*
[2] *ITER Organization, CS 90 046, 13067 Saint-Paul-lez-Durance Cedex, France*
[3] *All-Russian Electrotechnical Institute, 111250 Krasnoznamennaya, 12, Moscow, Russia*

Corresponding author: roshal@sintez.niiefa.spb.su

Similar to all large tokamak machines, in ITER the loop voltage needed for breakdown and plasma initiation will be generated using the energy stored in the magnet system prior to plasma pulse start. This is realized by inserting resistors in series with the center solenoid (CS) modules and two poloidal field (PF) coils, PF1 and PF6, with the help of DC circuit breakers. Moreover, make switches are used to change by step the voltage applied to the coils during plasma initiation phase and then to "push" it to zero by shunting the resistors per command from plasma control system. The switches for commutation of current in the coil circuits together with the resistors for extracted energy dissipation form the so-called Switching Network Units (SNU).

The paper focuses on the design of the main SNU components, whose specific features reflect high demands resulting from the ITER coil operation parameters. The key SNU components, i.e. high current fast operating switches, are grouped in Current Commutation Units (CCU) rated for 60 kA continuous current and 10 kV pulse voltage. The hybrid solution, i.e. the combination of a mechanical bypass switch (BPS) with a vacuum or semiconductor pulsed circuit breaker, has been further developed to achieve a longer life-time of more than 5000 operations. The BPS is comprised of two mechanical switches connected in series. One of them, fast open switch (FOS), interrupts current and transfers it to an intermediate thyristor at a very low voltage (< 15 V) to avoid arcing. The second, fast disconnect switch (FDS), serves to isolate the FOS from high voltage (8.5 kV) applied to the BPS, when current is transferred to the resistor. This is obtained by a thyristor circuit breaker equipped with a counterpulse capacitor bank. All CCU mechanical switches are based on similar design solutions, including water-cooled coaxial contacts and a powerful electrodynamic-pneumatic drive, which ensures very fast switch operation less than 5 ms.

Special design features of the SNU components allowing obtaining of the required characteristics are emphasized. In addition, the results of SNU circuit analysis are presented to justify the choice of the main parameters of the components.