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Current Center Line Measurement of ITER TF Coil

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Toroidal field (TF) coils are superconductive magnets which create magnetic field to confine plasma in ITER vacuum vessel. In order to confirm TF coil's functionality, magnetic field created by TF coil need to be evaluated and therefore, accurate measurement of current center line (CCL) is necessary. CCL of TF coil is defined as geometrical barycenter of all the conductors and accurate determination of CCL for TF coil is difficult due to two reasons: 1) after some steps through manufacturing, conductor positions within TF coil cannot be measured directly, 2) because each TF coil is composed of 7 double pancakes (DPs); 5 regular DPs and 2 side DPs, it is complicated to measure conductor positions within TF coil. To overcome those complications, a method to determine conductor positions by measuring magnetic fields of each DP, rather than TF coil, at surface of DP was proposed. From magnetic field simulation, magnetic field components are known to range from -0.02 T to $+0.02$ T at DP surface when direct current of 1 kA is supplied and magnetic field or its derivative takes local extrema above conductor position. In addition, it was calculated that a deviation of 1mm in one of conductor positions results in deviation of $5\mu\text{T}$ in magnetic field above the conductor. Therefore, in order to determine conductor positions of DP with 1 mm accuracy, a system capable of measuring magnetic fields from -0.02 T to $+0.02$ T with $5\mu\text{T}$ accuracy was developed. From the conductor positions of DP determined with this method, CCL of each DP and TF coil can be calculated very precisely.

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