

## Progress on Conceptual Design of the K-DEMO Magnet System

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**Abstract** — Korean Fusion Energy Development Promotion Law (FEDPL) was enacted in 2007 and a following step, a conceptual design study for a steady-state Korean fusion demonstration reactor (K-DEMO) has been initiated in 2012.

One special concept of K-DEMO is a two-staged development plan. At first, K-DEMO is designed not only to demonstrate a net electricity generation and a self-sustained tritium cycle (Tritium Breeding Ratio > 1.05), but also to be used as a component test facility. Then, at its second stage, a major upgrade is carried out by replacing in-vessel components in order to show a net electric generation on the order of 500 MWe. After a thorough 0-D system analysis, the major radius and minor radius are chosen to be 6.8 m and 2.1 m, respectively, considering practical engineering feasibilities. In order to minimize the deflection of wave and maximize the efficiency, a top launch high frequency (> 200 GHz) electron cyclotron current drive (ECCD) system is considered and, for matching the high frequency ECCD, a high magnetic field is required and it can be achieved by using high performance Nb<sub>3</sub>Sn-based superconducting magnet and the peak magnetic field is approaching to 16 T with the magnetic field at the plasma center ~7 T. As advantages of using high magnetic field, the operation limits of maximum plasma current and density can be increased and also a higher fusion power can be achieved with a same reactor construction cost. The K-DEMO magnet system consists of 16 TF coils, 8 central solenoid (CS) coils, and 12 poloidal field (PF) coils. Internally cooled cable-in-conduit conductors (CICC's) are used in all of the K-DEMO coils. Key features of the K-DEMO magnet system include the use of two TF coil winding packs, each of a different conductor design, to reduce the construction cost and save the space for the magnet structure material. The conceptual design of K-DEMO magnet system is presented together with preliminary design parameters.

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**Keywords (Index Terms)** — K-DEMO, superconducting magnet, graded TF Coil, helical cooling spiral, rectangular CICC.