# KSTAR Construction and Commissioning

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KSTAR's twelve years project has been officially completed by declaring the first plasma achievement on July 15, 2008. KSTAR, the first $Nb_3Sn$-based fully superconducting tokamak device, has come a long path, overcoming many difficult situations. The detailed engineering design and infrastructure setup for R & D have been completed in 2001. In March 2008, after the construction period of seven years, the KSTAR assembly has been completed, by connecting the cryogenic transfer lines between the tokamak and the cryogenic distribution system. The final critical issue was to complete the helium distribution system within six months in the condition of preliminary study.

The commissioning on KSTAR has been progressed from April to July, through the following four steps: vacuum, cryogenic cool down, superconducting magnet test, and plasma start-up. KSTAR has successfully passed the vacuum and cool down commissioning at the first trial. As scheduled, the basic environment with the vacuum at $3 \times 10^{-8}$ mbar and the temperature below 4.5K has maintained without any cold helium leak. Next, all of the superconducting magnets have been charged successfully without any serious faults. Plasma start-up experiments have been conducted using the integrated plasma control system (PCS) for fast current and position control. The first plasma discharge has been initiated under time synchronized operation of the power supplies, the ECH pre-ionization system, the gas-puffing system, and the initial set of diagnostics systems. After about 400 successive test plasma discharges, during which plasma was successfully controlled with a flat-top current of 120 kA, duration of up to 800 ms has been obtained at KSTAR. All plasma reproducibility has been verified by re-loading the PCS database. At the plasma start-up stage, it has also been verified that the key issues for the breakdown and the current ramp-up are: the null field, breakdown electric field, toroidal field, gas pressure, blip duration, ECH pulse length, and impurity control.

All results of each commissioning step have been verified by a special committee, whose members have been nominated by the Minister of Education, Science, and Technology. All of the commissioning contents, such as objectives, must-check items, target parameters, and commissioning results, will be presented in this paper. Specifically, various histories, such as vacuum, temperature, stress, plasma shot, and machine failure, will be reported.