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Experimental results from the first plasma operation and upgrade activities for KSTAR magnetic diagnostics

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1. INTRODUCTION

The magnetic diagnostics [1-5] for the Korea Superconducting Tokamak Advanced Research (KSTAR) device played an important role to accomplish the successful first plasma operation. They provided the essential parameters including the plasma current, loop voltage, poloidal flux, poloidal magnetic field, vacuum vessel current, and diamagnetic flux. The measured plasma current from the Rogowski coil was benchmarked with a line-integration of the poloidal magnetic fields measured from the magnetic field probes since the plasma current is one of the most important parameter to verify the successful mission for the first plasma campaign. The achieved maximum plasma current and duration were 130 kA and 750 ms, respectively, which are larger than the initial mission goals. The experimental results from the first plasma operation and further installation activities for the next campaign of the KSTAR magnetic diagnostics are discussed.

2. EXPERIMENTAL RESULTS FROM THE FIRST PLASMA OPERATION

Three Rogowski coils (RC), five flux loops (FL), sixty-four magnetic field probes (MP), three vessel current monitors (VCM), and one diamagnetic loop (DL) pair were installed for the first plasma operation of the KSTAR tokamak [4]. The RC, FL, MP, VCM, and DL measure the total plasma current, poloidal magnetic flux and loop voltage (LV), local poloidal magnetic fields for the plasma position control and

equilibrium studies, total vessel current, and plasma stored energy, respectively.

Figure 1 (a) and (b) show the plasma current measured by a Rogowski coil and calculated by a line-integration of the poloidal magnetic fields measured from the magnetic field probes, respectively. The shot number for this measurement is 794, which was the first successful discharge for which the plasma current was greater than 100 kA. Both results show similar results so that the plasma current measurements from the RC and MP sensors are promising not only for the first plasma campaign but also for the future long-pulse experiments with higher plasma current.

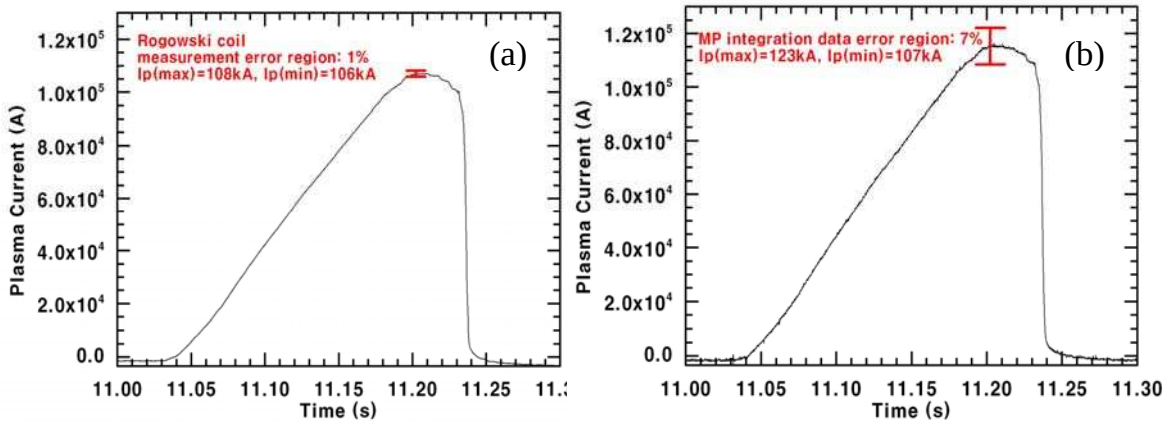

Fig. 1. (a) Plasma current measured by a RC.

(b) Plasma current calculated from the line-integration of the MP sensors.

Figure 2 shows a typical example from the magnetic diagnostics. All 40 sensor signals include 33 MP, 5 FL, and one pair of the DL are integrated by using a drift self-compensating analog integrators [6] for a duration of 20 sec. The other 37 sensor signals are not integrated but directly digitized after low-pass filtering since only 40 integrators were available for the first plasma experiment. Note that the FL signals have dual outputs. One signal is integrated for the magnetic flux measurement and the other signal is not integrated for the loop voltage measurement. The plasma was generated at about

9.0 sec. and sustained for approximately 0.23 sec. In Fig. 2, the middle, upper left, upper right, and lower right data show the experimental results from the MP, DL, FL, and LV, respectively.

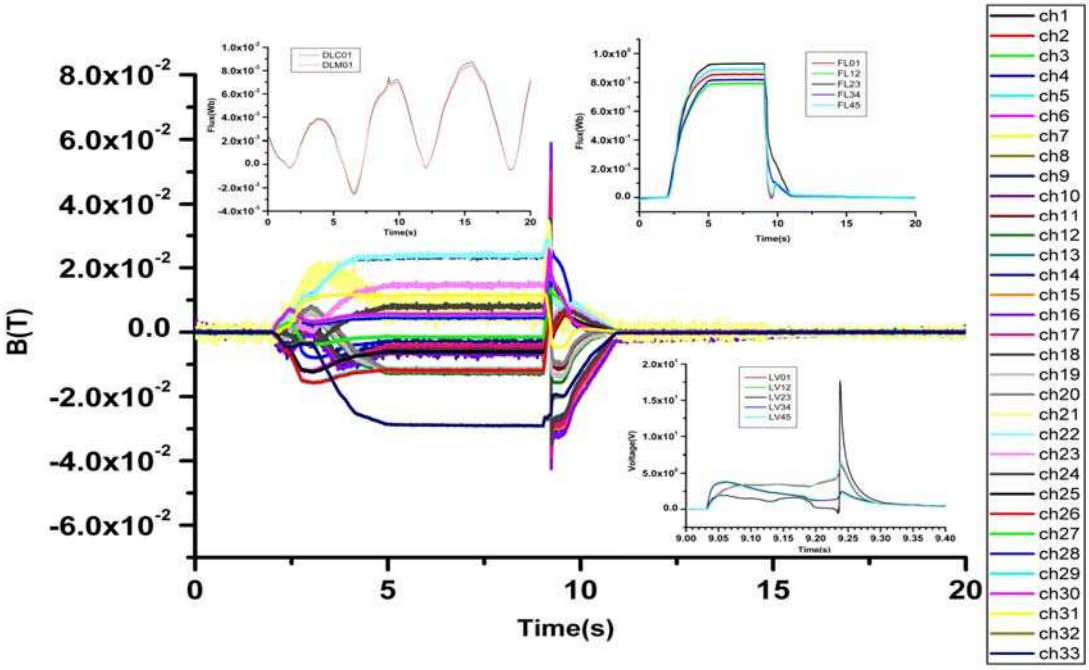

Fig. 2. A typical example from the magnetic diagnostics.

3. INSTALLATION ACTIVITIES FOR THE NEXT CAMPAIGN

Forty flux loops (FL), 168 magnetic probes (MP), 40 saddle loops (SL), 4 locked-mode (LM) coils, 45 Mirnov coils (MC), two diamagnetic loop (DL) pairs, and 48 halo current monitors (HCM) have been prepared for the year 2009 and 2010 campaigns. The saddle loops measure the poloidal magnetic flux differences in places where full flux loops are obstructed by ports. The locked mode coils measure the non-rotating or slowly rotating magnetic perturbations on the outboard midplane. The Mirnov coils measure magnetic fluctuations due to MHD activity. The halo current monitors measure the halo currents flowing in the internal structures. Figure 3 shows current installation activities of new magnetic diagnostics for 2009 and 2010 experimental campaigns.

Fig. 3. Installation of new magnetic diagnostics for 2009 and 2010 campaigns.

4. SUMMARY

The experimental results from the first plasma operation and current installation activities of the next experimental campaign for the KSTAR magnetic diagnostics are described. New magnetic diagnostics with about 350 sensors have been prepared for 2009 and 2010 experimental campaigns.

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