§72. Comparative Studies on Ohmic Inner and Outer Divertor Discharge Experiments in QUEST

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i) Introduction

Although a larger plasma current can be flown in a spherical tokamak (ST) due to larger plasma size compared to a high aspect ratio tokamak, it is difficult to ramp up large plasma current because the flux of the central solenoid (CS) is limited. In addition, as the divertor coil current induces the reverse loop voltage, the plasma current can be reduced. Therefore, careful operation is necessary in a ST with the small CS flux and divertors.

In this annual report, we report the comparative studies on the inner and outer divertor operations in QUEST with the plasma current of ~50 kA from the CS flux point of view.

ii) Outer divertor operation

Figure 1 shows the OH discharge waveform with outer divertor (PF35-2) operation for the plasma current of ~50 kA. As the mutual inductance between the plasma and outer divertor coil is large, the reverse loop voltage is induced as seen in Fig. 1-(f). However, as the divertor coil current variation is small as 0.8 kA, CS current variation is ΔI_{CS}=~6 kA to induce ~50 kA plasma current. As shown in EFIT in Fig.1, the divertor configuration is produced.

iii) Inner divertor operation

Figure 2 shows the OH discharge waveform with inner divertor (PF35-1) operation for the plasma current of ~50 kA. The divertor coil current is changed from -5 to - 8kA. However, as the mutual induction is smaller than that in the outer divertor coil, the reverse loop voltage is smaller. CS current variation is ΔI_{CS}=~6 kA to induce the plasma current, which is the same as in Fig. 1. The divertor configuration is produced as shown in EFIT in Fig.2.

So far we compared both divertor operations via limiter operation. In this fiscal year the direct comparison using the larger plasma current was possible by employing the separate power supplies, leading to more accurate studies. Therefore, this result may imply that both the snowflake divertor corresponding to an inner divertor and the super-X divertor corresponding to an outer divertor could be employed without large difference of CS flux consumption.

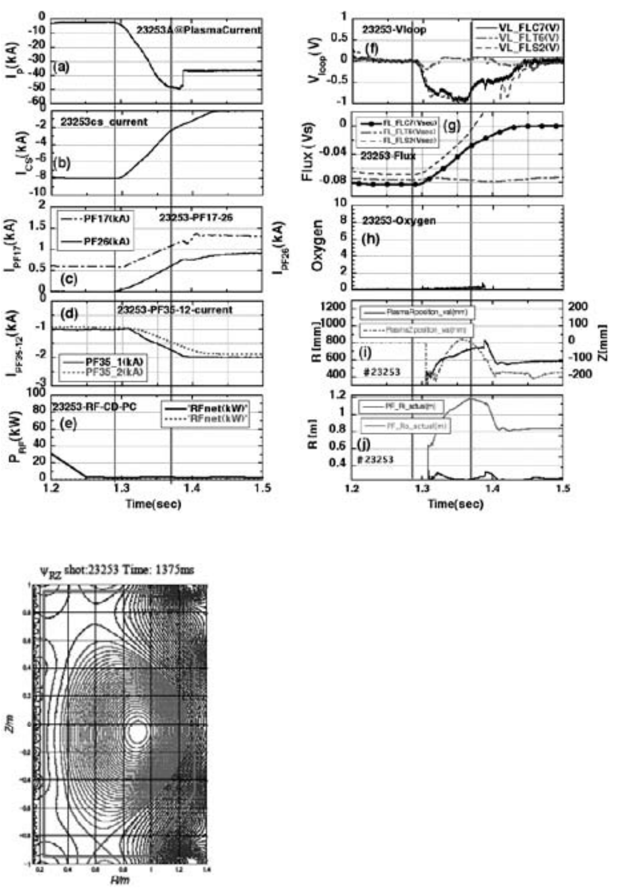

Fig. 1. Temporal evolution of outer divertor operation and EFIT equilibrium (#23253). (a) The plasma current I_p, (b) CS current I_{CS}, (c) PF26 and PF17 vertical field coil currents, (d) divertor coil current $I_{PF35-12}$, (e) RF power (f)loop voltages, (g) various fluxes, (h) Oxgen impurity line (i) plasma position of the center, and (j) plasma inner and outer edge. (Note: (e) RF power is shown earlier by 0.1s).

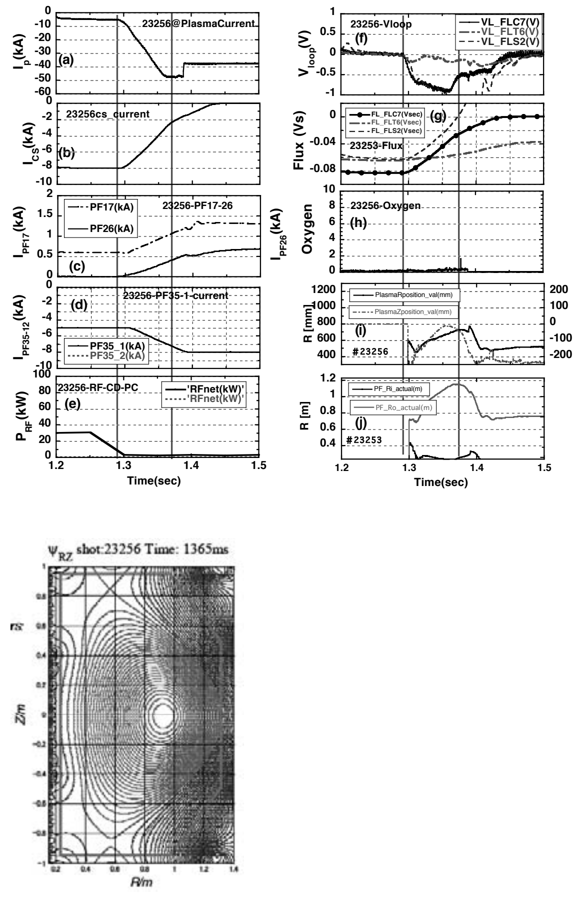

Fig. 2. Temporal evolution of inner divertor operation and EFIT equilibrium (#23256). (a) to (j) are the same as in Fig. 1.

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