§28. High RF Voltage and Long Pulse Test in RF Power Transmission System on ICRF Heating

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We have a plan for ICRF heating with high RF power, more than 10MW with 10sec and moderate power, 3MW with steady state, e.g. 30min. We have already developed an RF oscillator with 1.9MW with 10sec and 1.6MW for more than 1 hour[1]. The RF power is transmitted in a transmission line, which is composed of an RF antenna, ceramic feed-through and stub tuner(pre-stub tuner, stub tuner and liquid stub tuner as described in following sections). We constructed an R&D system for ICRF heating as shown in Fig.1. In this system, a 430mm wide and 630mm long proto-type antenna is installed in the vacuum tank, whose base pressure is kept under $2x10^{-7}$torr. When the maximum RF voltage is 40kV and 45kV in the standing wave, the power transmission capability is estimated at 1.6MW and 2MW, respectively for the case of the LHD plasma loading resistance of 5Ω. The final goal of this R&D is the achievement of 40kV/30min and 45kV/10sec. Here the RF loading is 0.3-0.4Ω because of no plasma, so that a relative lower RF power, e.g. 100-160kW can attain such a high RF voltage.

The domain of high RF voltage with short and long pulse operation achieved so far is shown in Fig.2. Vacuum pressure increase sometimes prevented long pulse operation, however, we succeeded in achieving 40kV/30min operation after aging and outgassing the transmission line and antenna with the aid of Ti-gettering. In the case of short pulse test, 58kV/10sec operation was achieved as shown in Fig.2. When the LHD plasma loading resistance is 5Ω, these data indicate that this system will be usable at 1.6MW ICRF heating with 30min and 3.4MW with 10sec, which exceed the RF oscillator capability. The R&D results demonstrate that the RF power transmission system is enough to make full use of the RF oscillator power output.

References

1) Kumazawa, R., Mutoh, T., et al., Proceeding of 18th Symposium on Fusion Technology(1996), P-D-20, to be published.

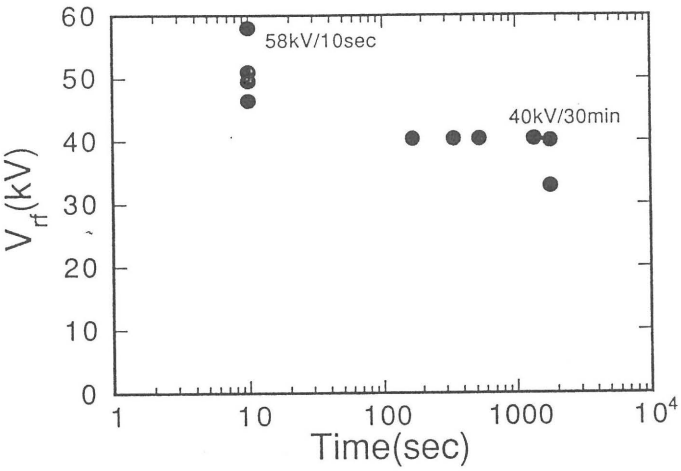

Fig2. RF voltage and pulse length in RF transmission system.

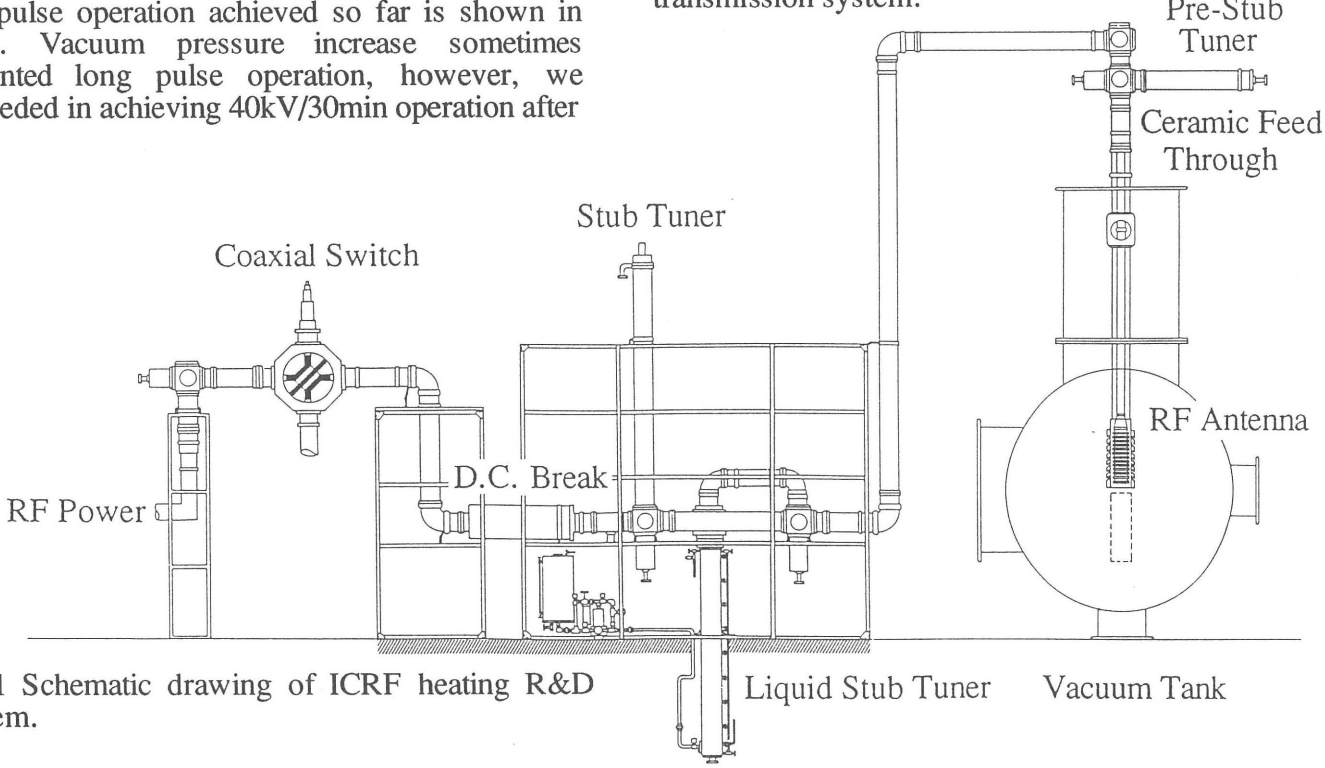

Fig.1 Schematic drawing of ICRF heating R&D system.