§17. Steady State Operation Test of ICRF Transmitter for LHD

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ICRF heating system has being developed for the steady state experiment in LHD. High power CW transmitter was one of the main R&D items and it was tested separately by using the dummy load instead of the antenna and impedance matching system. In 1995, the operation test reached to 1.6MW and 5000sec. This is the highest record in the world of the single transmitter in ICRF frequency range. The frequency tunning range of the transmitter is 25 to 100MHz continuously to fit the various heating modes in the wide magnetic field strength range of the LHD. Therefore, the LHD ICRF transmitter has special properties, which are the MW class output power, the wide frequency tunability and the steady state operation capability over 1hour.

The output cavity of the transmitter was specially designed and has the double co-axial cavity structure with double tuners they are used to adjust the impedance matching and the frequency tuning. Very wide range tunability is obtained by introducing the double coaxial cavity structure. The drawing of final power amplifier(FPA) is shown in Fig.1. The amplifier tetrode is 4CM2500KG(2274) Eimac tube. The tuning range of 25 to 100MHz is tested and confirmed at the low power cold test.

This FPA amplifier has been modified to fit the steady state operation. All spaces of the output and input cavities are intensively cooled by ventilation air flow. The ventilation paths are also shown in Fig.1. The coaxial line between the amplifier and the dummy load is also cooled by ventilation air. The used dummy load is specially designed for relatively low frequency range use. It consists of 96 water cooled ceramic resistors.

The record of the steady state test was developed step by step as shown in Fig.2. Two factors were effective. One is the strong cooling system for all parts and the another is the careful fine cavity tuning which can avoids the parasitic oscillation. Parasitic oscillation easily caused the out gassing of the tetrode and the over heat at the many unexpectable points. The operation region was extended to 1.6MW and 5000sec. as shown in Fig.2.

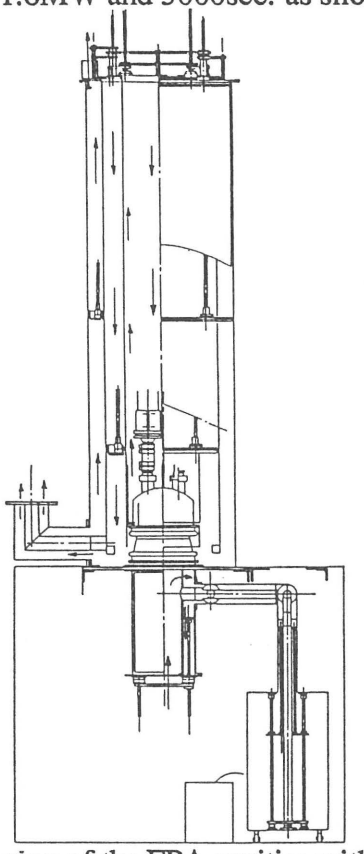

Fig. 1 Drawing of the FPA cavities with tetrode (4CM2500kG, Eimac). Ventilation air flows(arrows) are also shown.

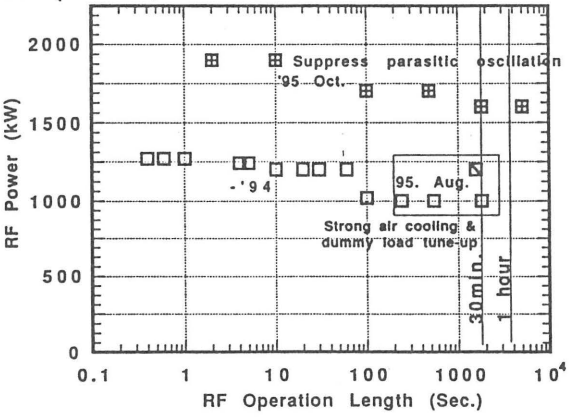

Fig. 2 High power and long pulse operation test of No.2 transmitter. 50 ohm dummy load was used. Frequency is 50MHz.

Reference

1)Mutoh,T., Kumazawa,R.,Seki, T., Simpo, F., Masuda,S., Watari, T., Fusion Engineering and Design 26 (1995) 387

2)Mutoh,T., Kumazawa,R.,Seki, T., Simpo, F., Masuda,S.,Ido,T., Watari, T., in Proceedings of Simposium of Fusion Engineering. '95, Illinois