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Development of the Double Liquid Stub Tuner for the KSTAR ICRF

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1. Introduction

An ion cyclotron range of frequencies (ICRF) system is an important method to heat plasmas and to drive a non-inductive current in fusion devices. The high power RF transmission components are required for transmitting the MW level of RF power continuously in the ICRF heating and current drive system To transmit the high RF power (MW level), the co-axial transmission line must withstand the high RF voltage (> 35 kV) for a long time. A conventional stub tuner has some problems due to the difficulties in fabricating a straight coaxial line, local temperature increase and insulation breakdown for a long pulse operation under a high power. To solve such problems, the liquid matching components, liquid stub tuner and liquid phase shifter, using liquid instead of gas for insulating dielectric medium was developed. The liquid stub tuner can be used reliably in the continuous high power RF facilities since it has no sliding contact and can withstand the high RF voltage (> 40 kV). Double liquid stub tuner made of 9-3/16″ nominal diameter aluminum transmission line is being developed for a method of the liquid matching system. The control system for liquid transportation system between liquid stub tuner and reservoir is upgraded.

2. Simulation of double liquid stub tuner

The schematic diagram of the double liquid stub tuner system(DLSTS) for the liquid matching system was shown in figure 1. RF power of the transmitter transfers to the double stub tuner through gas breaker which blocks the pressurized gas from the transmission line to transmitter, and directional coupler. Before the DLSTS is constructed, simulation is performed with ADS code (Advanced Design System) to find the matching condition of the DLSTS.

The simulation model is showed in Figure 2. With the simulation result, the length of the transmission line and the level of the liquid are calculated. The length of the transmission line between the liquid stub tuners is calculated with the value of 1,100 [mm], the liquid level of the left-side and right-side DLSTS is calculated 1,950 [mm] and 1,550 [mm], respectively.

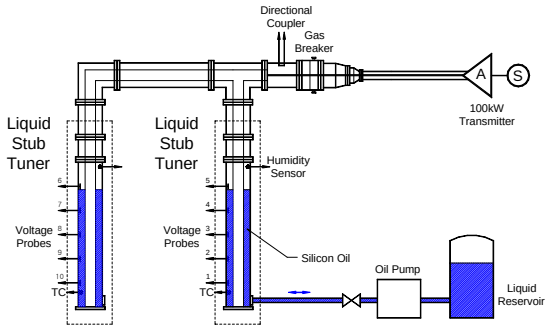

Figure 1. A schematic diagram of the double liquid stub tuner system.

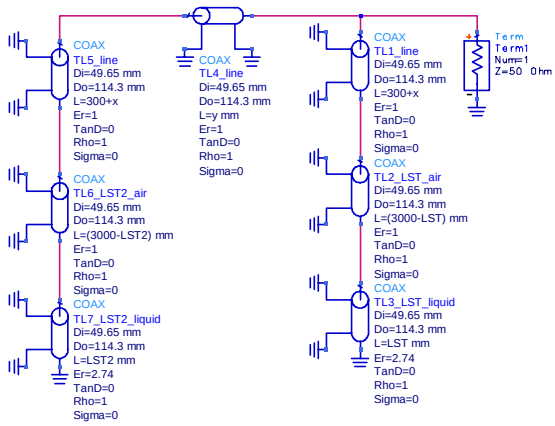

Figure 2. A simulation model for double liquid stub tuner system.

3. Upgrade of the control system for double liquid stub system

A set of the liquid transportation system (LTS) has been fabricated and tested. [1] The control system for LST has been upgraded. The control system of the LTS is composed liquid level display of the liquid stub tuner, part of speed control, and valve control. The picture of the upgraded control system showed figure 3.

Figure 3. Upgraded control circuit of the DLSTS.

4. Conclusion

The simulation for DLSTS is performed to find the matching condition. With the simulation result, the length of the transmission line and the level of the liquid are calculated. The upgraded control circuit for liquid transportation system is developed. The new developed liquid transportation system is composed liquid level display of the liquid in the liquid matching system, part of speed control, and valve control. The DLSTS is being fabricated and will be accomplished high power test.

REFERENCES

[1] Jae Sung Yoon, Bong Guen Hong, and Dong Chul Park, 2005 vol. 21 Proceedings of the Korean Nuclear Society Fall Meeting, Busan, Korea, Oct. 2005.