§6. Improvement of ICRF Antennas

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During the 6th LHD experimental campaign, water leakage in an ICRF antenna happened. After dissembling of the antenna, a small hall due to RF arcing was observed at the inner co-axis line bellows shown in fig. 1. These bellows are attached for the absorption of extension by temperature increase. Inside the inner co-axis line, water is flowing for the antenna cooling. Thickness is 0.4 mm. The operating frequency was 38.47 MHz at the water leakage. In this frequency RF standing voltage was almost maximum at the position of leakage hole.

To improve the antenna performance, some parts are modified as follows.

- Covering around bellows
- Improvement of Faraday shields
- Enlargement of carbon side limiter
- Installation of antenna monitors

(1) Covering around bellows

Figure 2 shows the corona ring which covers the bellows. It protects thin bellows. High voltage induces the arcing between the cover and outer co-axial line. The voltage inside the cover is small therefore no arcing inside the cover will happen. The port side bellows is not covered because the voltage is almost zero for the ordinary frequency of 38.47 MHz.

(2) Improvement of Faraday shields

Water flowed inside the Faraday shield pipes. Therefore there was a risk of water leakage from Faraday shields. We changed the thickness of Faraday shields from 1.0 to 2.2 mm for No. 3.5 port antennas. We exchanged the Faraday shields of No. 4.5 and No. 7.5 port antennas from the water-cooling type to the thermal-conductance-cooling type. Faraday shield rod is a cladding type (copper rod coated by stainless steel) as shown in fig. 3. For the thermal-conductance-cooling type, the maximum temperature rise due to the RF field during steady state operation of 500 kW was estimated to 58 ℃. It is tolerable value.

(3) Enlargement of carbon side limiters

The Faraday shield is very close to the plasma. During the normal operation, the distance between the last closed flux surface of plasma and Faraday shields is 3～7 cm. Front edges of carbon protectors were positioned 5～10 mm from Faraday shields. We changed this distance to 20 mm to protect the Faraday shields.

(4) Installation of antenna monitors

To detect various troubles in the antenna, we prepared for the infrared camera for 7.5 antennas and visible lay fiberscope for 3.5 antennas.

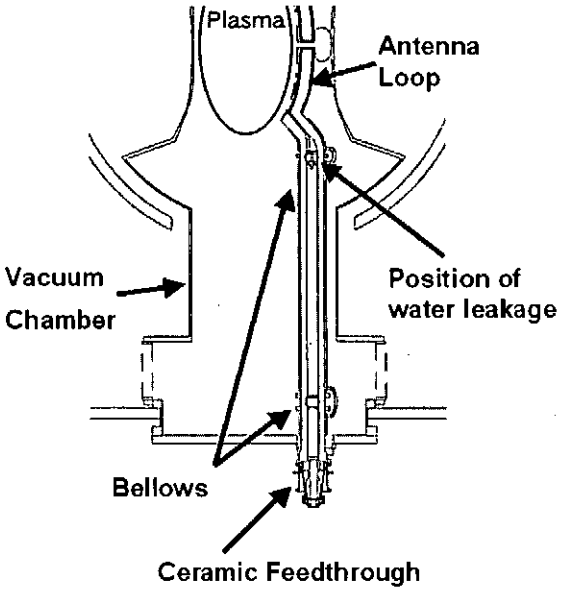

Fig. 1 Position of water leakage

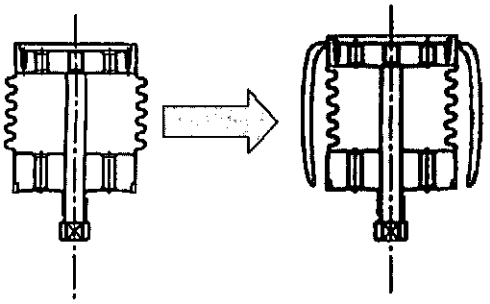

Fig. 2 Covering around bellows

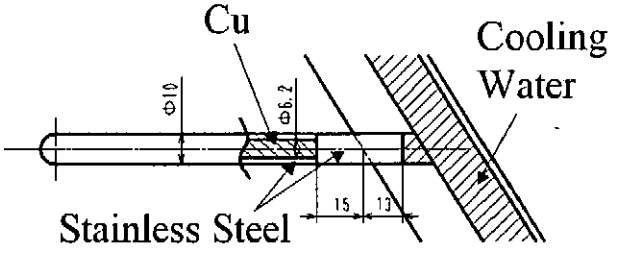

Fig. 3 Structure of new Faraday shield