§5. Completion and Testing of Long Distance Corrugated Waveguide Transmission Line

Kubo, S., Idei, H., Yoshimura, Y., Shimozuma, T., Sato, M., Ohkubo, K., Watari, T., Kobayashi, S., Takita, Y., Ito, S.

Sasaki, S., Kanai, Y., Wakabayashi A., Hayakawa A., Kawashima, S., Saito, F., Hayashi, K., Hirata, Y., Yamada, D., Komuro, M.
Toshiba Co.

Four lines of ECH transmission line from heating equipment room to the LHD have been completed. The CPI#1R gyrotron at 84GHz and GYCOM gyrotron at 82.6 GHz are installed in the heating equipment room. The millimeter wave power have been transmitted through corrugated waveguide system. The part of heating equipment room and under ground part of the corrugated waveguide system had been completed last fiscal year. In this fiscal year, the part in the LHD main hall including the transmission stage, supporting structures on the LHD bell jar, is completed and used for the first plasma production. Four complete set of corrugated waveguide transmission system are connected from heating equipment room to the LHD. Bird eyes view of the whole waveguide system is shown in Fig. 1.

Owing to the broad band characteristics of the corrugated waveguide system, The lines which originally designed for 168GHz can be used for 84GHz and 82.6 GHz. so that less than four lines of corrugated waveguide system are used for the 82.6 GHz, 84GHz, and 168 GHz in accordance with the purpose of the experiments. The frequency specific components are grating polarizers, window assemblies. Two gyrotrons CPI#1R (84GHz) and GYCOM (82.6 GHz) were used for the LHD first plasma campaign. The line used for 84GHz CPI#1R includes 120m straight corrugated waveguides and 22 mitre bends and finally connected to 5.5U antenna. That for 82.6 GHz GYCOM has similar length and 19 miter bends and goes to 9.5U antenna. Fig.2 shows the route of the ECH transmission lines above LHD. In order to guarantee the mechanical insulation between LHD bell jar and ECH transmission stage, the combination of the sliding waveguide section and rotatable miter bends are adopted in the connecting part of the corrugated waveguide which resulted in the increase of the number of the miter bends.

The estimated transmission efficiency at 84GHz from heating equipment room to the bell jar of LHD is about 80% which indicates the loss per miter bend is in between 1 to 2 %. Inside of the corrugated waveguide system are replaced by dry nitrogen to prevent the arcing inside.

Output beam from MOU is connected to the corrugated waveguide transmission system through roof top-type polarizer. This polarizer is necessary to control the polarization of the input beam to LHD. Due to the complex combination of the miter bends, a code to calculate the desired polarization direction is developed and the polarizers are set so that the polarization on the mid-plane of the LHD become X-mode for 84GHz during the first plasma campaign.

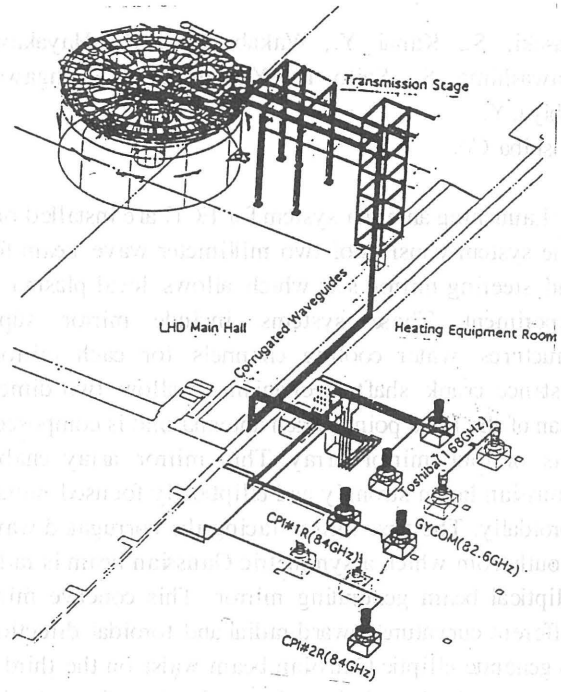

Fig. 1 Birds eyes view of completed waveguide transmission nes from heating equipment room to LHD main hall.

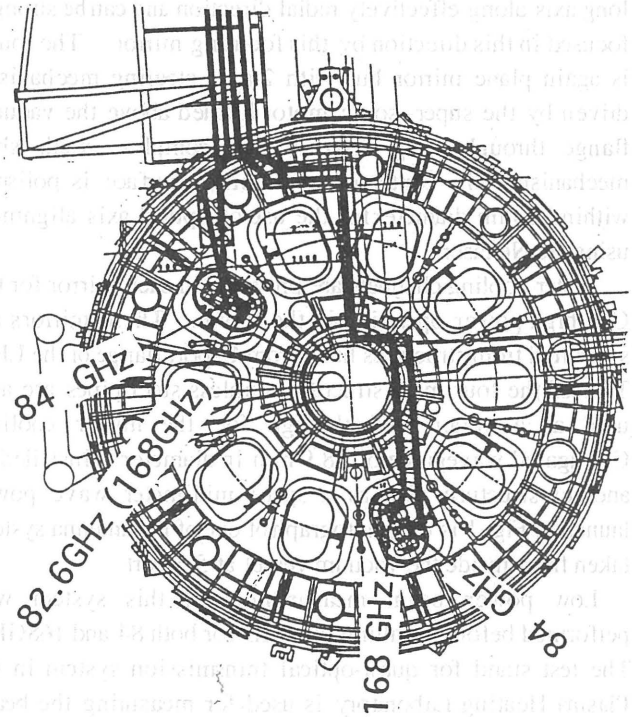

Fig. 2 The ECH corrugated waveguide transmission line route on LHD bell jar.