

Progress in Development and Fabrication of the JT-60SA ECH/CD System

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Development of the ECH/CD system for JT-60SA has been progressed. Successful results on the JT-60SA gyrotron development for multi-frequency, high-power, long-pulse oscillation such as 1 MW/100 s at both 110 and 138 GHz, 1.9 MW/1s and 1.5 MW/5s at 110 GHz, 1.3 MW/1.2 s at 138 GHz and 1 MW/1 s at 82 GHz were reported in IAEA FEC in 2014 and 2016. The development of the high-power, long-pulse and multi-frequency JT-60SA ECH/CD system is now focusing on the launcher, transmission line (TL), control and power supply. In addition, design, fabrication and testing of a part of these components have been progressed toward start of the first plasma experiment of JT-60SA.

The main results achieved in this time are as follows. (i) A full length (~7 m) mock-up of the mirror steering structure of the launcher has been successfully tested in vacuum. The required life without maintenance, which is 10^5 cycles for the poloidal steering range of 60° and 10^4 cycles for toroidal beam steering range of 30° , has been achieved. A newly introduced solid lubricant enabled the smooth movement of the steering shaft by reducing the sliding resistance between balls and rail/block of the linear guide used in the steering structure. (ii) The temperature rise distribution of aluminum waveguides has been measured at high-power of 0.5 MW. It is in the range from 0.2 to 1.2 °C per 1 MJ transmission and acceptable for 1 MW/100 s (100 MJ) transmission required in JT-60SA. (iii) The preparation of the JT-60SA ECH/CD system is progressing as planned. For instance, an ECH/CD control system has been designed with a layered and distributed structure to achieve sufficient flexibility for upgrading and for easy optimization depending on the experimental purposes. In addition, fabrication of TL components including waveguides, cooling and vacuum system has been started. Moreover, the new power supplies for two gyrotrons (1 MW/100 s each) have been designed and the fabrication has started by F4E as a part of broader approach activities.

The above discussed progresses in the launcher/waveguide developments and the design /fabrication of the JT-60SA ECH/CD system components significantly contribute to smooth start of the JT-60SA experiment and improve the plasma performance with high reliability and flexibility.

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