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P4.081 High voltage electrical system of 8.56 GHz CW klystron for electron cyclotron heating on QUEST spherical tokamak

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Current start-up experiment and Steady-State Tokamak Operation (SSTO) are performed by Electron Cyclotron Heating (ECH) in QUEST spherical tokamak. SSTO discharge can be maintained longer than 2 hours using continuous 8.2 GHz ECH. For a new ECH for SSTO, 8.56 GHz high power klystron system is in preparation. The klystron can work continuously, and its incident RF power is 250 kW maximum. Therefore, SSTO using 8.56 GHz-ECH is promising to generate higher fluxes of heat and particle than those of 8.2 GHz-ECH plasma. The antenna structure for 8.56 GHz EC wave is a focusing mirror and its beam waist is about 20 cm diameter around EC resonant layer. O- and X-mode can be selected by the polarizer unit.

The high voltage (HV) DC power supply for a cathode of the 8.56 GHz klystron has been installed. It needs to satisfy the specification; maximum voltage $V_{max} = -54$ kV, maximum current $I_{max} = 13$ A, and working continuously. The output voltage is adjustable under control by thyristors. Its output current depends on beam current of the klystron as a load. HV must be turned off immediately to protect the klystron when arcing events inside the tube or in the transmission line are detected. IGBT-array in series switches off the HV in 20 μ s, where the thyristor-switch is relatively slow. In addition, power receiving of 6.6 kV three-phase AC is controlled by three pairs of a HV switch and an IGBT stack. The HV switch is connected only when the sequence of the klystron operation is on. IGBT stacks are required to turn off 6.6 kV AC faster than HV switches when errors are received. After following actual load test with the klystron, RF output trial and ECH experiment on QUEST is planned.

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