

Outcome of R&D program for ITER ICRF Power Source System

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As a part of in-kind contribution, India is responsible to deliver nine numbers (1 Prototype + 8 series production) of RF Sources to ITER system, each having power handling capability of 2.5 MW/CW at VSWR 2:1 in the frequency range 35 –65 MHz or 3.0 MW/CW at VSWR 1.5:1 in the frequency range 40 –55 MHz, along with other stringent requirements. As there is no such amplifier chain able to meet the output power specifications as per ITER need, the RF source consists of two parallel three-stage amplifier chains, with a combiner circuit on the output side. This kind of RF source is unique in terms of its stringent specifications. A voluntary R&D program by India has been initiated for establishing the high power technology prior to Prototype and series production, using Diacode and Tetrode tubes. In this program, single chain experimentation at 1.5MW for 2000s is conducted for the frequency range 35-65 MHz up to VSWR 2:1, with any phase of reflection coefficient. The main objective for the R&D test is to confirm the system performance for the power, duration and frequency range as per ITER need and to check the reliability of both the tube and the amplifier with matched as well as with mismatched load (up to VSWR 2:1), which essentially simulates the plasma load condition. To support the R&D program, a dedicated high power test facility has been developed at ITER-India to test RF amplifiers based on both the technologies. For Diacode based system, high power ITER relevant tests completed in 2016 and reported elsewhere [1]. Over the past two years, assembly and integration of R&D RF source using Tetrode technology at Indian test facility is completed with validation of all the relevant sub-systems/systems as standalone mode. The high power RF test using Tetrode based RF amplifier achieved 1.7MW of power for 3600s duration at 36 MHz. For other ITER operating frequencies, the system was operated at 1.5MW/2000s successfully.

This paper reports commissioning of RF amplifier using Tetrode technology with various operating scenarios, dissipation limit, safety system and challenges faced during high power operation at Indian test facility and describes the final outcome of R&D activity.

[1] Aparajita Mukherjee et. al., Progress in High Power Test of R&D Source for ITER ICRF system, 26th IAEA FEC 2016, 17-22 Oct 2016, Kyoto, Japan

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