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Progress in High Power Test of R&D Source for ITER ICRF system

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The IC H&CD system is one of the major tools for achieving the plasma performances foreseen in ITER's operation scenario. This system is designed to provide 20 MW into the plasma, at frequencies included in the band 40 MHz to 55 MHz. For ensuring 20 MW power availability for plasma operation, 24 MW is required at the output of the RF sources. India is responsible to deliver nine numbers of RF Sources to ITER system. Each source shall have the 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 requirement. An urgent need for pre-qualification of final stage tube and few critical components is established through R&D program to bridge the significant gap between demonstrated capability of RF source system at various worldwide fusion facilities vs. ITER need, in terms of power level, pulse duration & bandwidth (BW) requirement.

In 2012, ITER-India has signed contract with Thales Electron Devices (France) for establishing the technology in very high power RF amplifiers, using Diacrode tube. The contract is to design & develop driver and final stage amplifiers. Tubes and cavities are integrated in full amplifier chain developed by ITER-India. To test the performance of the amplifier chains at matched and mis-matched load condition, high power Test Rig (3MW/CW capability) is developed at Indian test facility.

After successful assembly & integration of RF amplifier at Indian test facility, high power RF tests initiated. The objective for the tests is to confirm 1.5 MW output at 35 - 65 MHz for 2000 seconds with 1MHz BW (at 1dB point) over central frequency and to check the reliability of both the tube and the amplifier with a mismatched load (up to VSWR 2:1) which simulates power transmission to an antenna coupled to the plasma. This paper reports successful commissioning of RF amplifier and the achievement of 1.5 MW of RF power for more than 2000s, confirming other extremely challenging specifications and describes the operating scenarios, dissipation limit, safety system and various infrastructures developed at Indian test facility to support such operation.

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