

3MW Dual Output High Voltage Power Supply Operation: Results for Accuracy, Stability and Protection Test

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High temperatures inside tokamak for fusion research is achieved from auxiliary heating systems like neutral beam injectors (NBI), or RF heating devices, viz., ion cyclotron (IC), electron cyclotron and lower hybrid systems where High Voltage Power Supply (HVPS) is an essential requirement. ITER requires 20 MW of ICRF for heating and driving plasma current. A cascaded chain of amplifier is a practical solution due to limiting level of power with available vacuum tubes. Each chain of amplifier has to provide 1.5MW power in frequency range of 35- 65 MHz for 3600 seconds. The system must be capable to operate both at matched and mismatched load condition (VSWR 2) [1].

HVPS based on pulse step modulation (PSM) topology has already demonstrated its ability for broadcast transmitters, accelerators using radio frequency (RF) source and neutral beam injectors. A novel concept of tapping two outputs from single PSM based HVPS is attempted for the first time. A PSM based HVPS is developed with dual output to feed driver and end stages of a high power RF amplifier [2].

Developed dual output HVPS is capable of providing 14 - 18 kV, 250 kW to driver stage and 16-27 kV, 2800 kW to end stage of a RF amplifier chain, simultaneously [3]. Present article covers the validation of dual output HVPS for integrated operation with RF Amplifier system. It includes wire burn test conducted at the output of HVPS, demonstrating tight synchronization among both stages. Test set up, gauge/length for fuse wire to meet the critical energy limit qualifications is presented. HVPS performance parameters viz. ripple, regulation and stability over extended duration of 3600 seconds are presented for various scenario of RF Amplifier operation. Implemented scheme for protection against overvoltage and overcurrent is also discussed.

[1]Aparajita Mukherjee et al., "Progress in High Power Test of R&D Source for ITER ICRF system", unpublished, FEC 2016.

[2]A.Patel et al., "Development of 3 MW Dual Output High Voltage Power Supply for ICRH System", International Power Modulator and High Voltage conference (IPMHVC-2016), San-Francisco, July 5-9, 2016

[3]A.Patel et al., "Initial operation of 3 MW dual output high voltage power supply with IC RF system", Fusion Engineering and Design, Volume 126, January 2018, Pages 59-66.

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Author: Mr PATEL, AMITKUMAR (INSTITUTE FOR PLASMA RESEARCH)

Co-authors: Mrs MUKHERJEE, APARAJITA (ITER-INDIA); Mrs THAKAR, ARUNA (ITER-INDIA); Mr RAVAL, BHAVIN (ITER-INDIA); Mrs SONI, DIPAL (ITER-INDIA); Mr UPADHYAY, DISHANG (ITER-INDIA); Mr DHOLA, Hitesh (ITER-India, IPR); Mr MEHTA, KUSH (ITER-INDIA); Mr SINGH, NARIDNER PAL (ITER-INDIA); Mr GOSWAMI, NIRANJANPURI (ITER-INDIA); Mr SINGH, RAGHURAJ (ITER-INDIA); Mr TRIVEDI, RAJESH (ITER-INDIA); Mr KUMAR, RAJNISH (ITER-INDIA); Mr DAVE, RASESH (ITER-INDIA); Mr GAJJAR, SANDIP (ITER-INDIA); Mr VERMA, SRIPRAKASH (ITER-INDIA); Mr BARUAH, UJJWAL (ITER-INDIA); Mr GUPTA, VIKRANT (ITER-INDIA)

Presenter: Mr PATEL, AMITKUMAR (INSTITUTE FOR PLASMA RESEARCH)

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