Seminar

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Institute for Plasma Research

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Title: Optimization of the output filter for micro-second transients in PSM based Mega-watt HVPS

Speaker: Mr. Dishang Upadhyay

ITER India, Institute for Plasma Research, Gandhinagar

Date: 11th September 2023 (Monday)

Time: 3:30 PM

Venue: Seminar Hall, IPR

Abstract

Electron cyclotron heating (ECH) in nuclear fusion devices utilize MW gyrotrons fed by high voltage power supplies (HVPSs). HVPS with fast voltage ramp up time of 40μs with overshoot <2%, settling time better than 20μs and ripple <1% is a pre-requisite condition. These high-power RF devices (gyrotrons) are very sensitive to overshoots and settling time of fast rising voltage pulses.

The 6MW, (-)55kV PSM based HVPS at ITER-INDIA lab can cater simultaneous operation of two 1MW gyrotrons. Besides fulling microsecond settling time and critical joule energy requirement of less than 10 Joules, the HVPS should deliver optimal performance even under partial loading conditions of single gyrotron.

The desired μs transient performance is significantly impacted by various factors, length of the output cables and the specific load conditions including the combination of output filters. The optimization techniques are assessed and employed to minimize overshoots in mega-watt HVPS systems without compromising the fast ramp-up and ramp-down characteristics. Further to validate the effectiveness of the proposed solution, the optimized damped filter configurations are implemented and tested under partial load conditions of approximately 2.5MW. The results demonstrate the improvements achieved and highlight the significance of these techniques in enhancing the performance and stability of high-power HVPS systems.

In addition to the aforementioned requirements, the updated optimized filter configuration also minimizes overshoots during load modulation scenarios demanded by triode type gyrotrons, where HVPS current experiences rapid rise and fall times of 50μs and 10μs, respectively.

Keywords: High voltage power supply (HVPS), Pulse Step Modulation (PSM), Regulated HVPS, settling time, Voltage overshoot