Seminar

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Institute for Plasma Research

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Title: Design and Development of High Voltage DC Power Supply for the Nuclear Fusion Application: Overview & Challenges

Speaker: Mr. Ashok D. Mankani
Institute for Plasma Research, Gandhinagar

Date: 11th May, 2026 (Monday)

Time: 3:00 PM

Venue: Seminar Hall, IPR

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Abstract

Institute for Plasma Research (IPR) under its domestic Fusion Technology development program designed and developed a prototype 300 kV/2 A DC High Voltage Power Supply (HVPS) system which is upgradable to 500 kV. The power supply design proposed is best suited for powering Accelerator Grids of High Power (≥ 1 MW) and High Energy (≥100 keV) Neutral Beam Injector (NBI) an important Heating & Current Drive (H&CD) system used in magnetic confinement reactor such as TOKAMAK for fueling, heating, and confining plasma; effectively contributing to minimum condition defined as Lawson Criteria for Nuclear Fusion.

Some of the major design challenges raised by NBI are voltage regulation 10% - 100%, stability ≤ 1%, ripple ≤ 5%, overshoot ≤ 10 %, repeated breakdown/short-circuit withstand capability, energy transferred to grid system in the event of breakdown ≤ 10 J, fault clearing time ≤ 100 µs; and compliance to Indian Electricity Grid Code (IEGC) in terms of Total Harmonics Distortion (THD) as per IEEE 519, Power Factor (PF) ≥ 0.85, and short term Flicker severity (Pst) as per IEC 61000-3-3. On the other hand development challenges are attributed to High Voltage Engineering feasibility such as Reliability, Availability, Maintainability and Inspectability (RAMI) of the components/sub-systems used in HVPS.

This paper gives an overview of 300 kV/2 A DC Power Supply as has been design and developed elaborating the topology of power converters used viz. Rectifiers and Inverters, its integration, testing and commissioning to generate voltage upto 300 kV. Also several challenges faced during design, development, testing, characterisation, and operation of the HVPS are discussed.

References:

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