POWER SUPPLY UPGRADES FOR IMPROVED PLASMA DISCHARGES IN ADITYA TOKAMAK

C. N. Gupta & Aditya team

Intitute for Plasma Research, Bhat, Gandhinagar 382 428, India

Corresponding author: cngupta@ipr.res.in

ADITYA Tokamak is presently operating with Ohmic coils with stored flux of 0.4 Vs and suitable for high di/dt effected by current commutation and wave shaping thereby producing the required loop voltage in the range of 18 to 26 volts. Besides controlled vertical field gives radial equilibrium at a toroidal field (B_t) of 0.75 to 1 T. This results in a plasma current of ~90 kA for a duration of ~120 msec with a flat top period of ~30 msec, electron temperature ~200 eV and electron density ~$1.5x10^{19}$ m^{-3}.

In most of the Aditya shots, ohmic coil is magnetized to 12 to 14 kA and it stops at zero of positive converter, which includes plasma breakdown, current ramping and holding flat-top for a short durations. In order to increase volt-sec (0.4 to 0.8 Vs) in the ohmic heating circuit it is made to swing in negative directions without any dead band with the help of circulating and negative converters. These shall increase the flat top duration of plasma current to over a period of 100 msec at a plasma current of ~100 kA. It is seen the loop voltage requirement at flat top is close to 2.2 to 2.6 V, which requires current in ohmic circuit to fall at the rate of 60~76 kA/sec considering the circuit parameters. In the present scenario it is also seen that the dip in loop voltage reflects a corresponding decrease in plasma current during the cross over phase from positive to negative converter. This necessitated for modification of the circulating converter ratings. A new set of rectifier transformers of 2750 KVA is put in the circulating mode, which is rated for 3000 A DC/ 1650 V. An advantage of using circulating converter is that it allows maintaining loop voltage (i.e. maintaining constant di/dt on primary) at the positive current reaching to zero & crossover before the negative converter current is brought up. Current zero in the positive converter results in its self turn off and in the intervening period the ohmic current is driven by the circulating converter which has the capacity to go upto -3 kA in negative direction. At this instant circulating stops and full negative converter is turned on. This results doubles the volt-sec to 0.8. In its perspective, to obtain the Ohmic heating system and quality of plasma current drive in Aditya Tokamak discharges it is not possible without the proper involvement of circulating rectifier.

In order to save volt-sec during plasma ramp up phase vertical field power supply is slightly modified to support plasma current rise of 6 to 8 MA/sec with the help of an added capacitors. It has shown high rate of rise of plasma current (~ 6 MA/sec) and improvement in discharges like better positioning, less carbon emissions, savings in Vs, etc. Further to correct the radial plasma position in faster time scale a new fast-transistorized dual polarity power supply is used along with a separate set of coils that are laid closer to the vessel. This dual polarity power supply provides control in either radial direction with the on line measured position signal.