AN INDIAN TEST FACILITY TO CHARACTERISE DIAGNOSTIC NEUTRAL BEAMS FOR ITER

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The negative ion source based diagnostic neutral beam (DNB) line is expected to deliver 18-20 A of 100 keV, beam of hydrogen neutrals to the ITER plasma. The beam, with a 3s ON/20s OFF duty cycle and modulated at 5 Hz, shall be used to diagnose the He ash content in the D-T phase of the ITER machine using the charge exchange recombination spectroscopy (CXRS).

The challenges involved in DNB delivery include1) producing an extracted current density from the source needs to be 34.5 mA/cm^2 , in order to obtain accelerated beam with a current density of ~ 30 A/cm² over the 1280 apertures 2)transport to focal point, defined as 20.665 m from the grounded grid of the ion source; 3) filter field effects on beamlet dispersion and deflection 4) compensation of the beamlet deflection due to magnetic fields of the source and the suppression magnets using aperture offset technique, 5) effect of field shaping plates on the deflection of the outermost beamlets due to space charge repulsion from the neighbouring beamlets, 6) effect on the beam optics due to bending of grid segments under heat loads from incident co-extracted and stripped electrons 7) beam focussing using geometric aiming and aperture offset 8) effect on the beam transport due to presence of small stray tokamak fields in the neutraliser 9) functionality of the beam line components

DNB delivery to ITER shall be aided if the above effects related to beam production, its neutralisation and transport over 20.665 m are tested prior to its onsite commissioning. As DNB is a procurement package for INDIA, an ITER approved test facility (INTF) is being constructed in the Institute for Plasma Research (IPR), India The timeline for this facility is synchronised with the RADI, ELISE (IPP, Garching), SPIDER (RFX, Padova) in a manner that best utilisation of configurational inputs available from them are incorporated in the design. International collaboration with these laboratories is envisaged to enable exchange of ideas, experiences and databases to aid the progress and delivery of such a facility.

The INTF is a combination of a 10 m long vacuum vessel with a duct similar to the one envisaged in ITER. The beam source is adopted from the European design, the accelerator, the beam line components and the power supplies shall conform to the ITER DNB configuration. The beams shall be tested for a duty cycle of 3 S ON/20 S OFF with a 5 Hz modulation once again inkeeping the with ITER requirements. The facility is envisaged to be operational in 2014 Q4. This paper shall describe the facility in detail and discuss the experiments planned to optimise the beam transmission and testing of the beam line components using various diagnostics.