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Diagnostic beam for ITER (INTF): Status and accompanying research

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The Diagnostic Neural Beam (DNB) for ITER is a part of India's in-kind commitment to ITER. The 100 keV 20 A Ho beam shall be used to monitor He ash fraction using the CXRS diagnostic technique. Realizing DNB to meet the operational goals is challenging both from the engineering and operational perspectives.
The engineering perspective of first of kind large sized components includes various aspects of materials, precision machining over sizeable areas, jointing of similar and dis-similar materials, assembly, alignment and testing to ensure the strict quality and safety norms. Compliance is necessary to enable components to survive the life time of ITER with minimal maintenance requirements. From the point of view of operations, 100 keV 60 A H- beams are required from 1280 beamlets extracted and accelerated from the 2 m x 1 m ceisated RF source with a beamlet divergence between 5-7 mrad. At ITER India both these perspectives have been addressed in parallel.
On the engineering front, DNB beam line components like the neutralizer, electrostatic residual ion dump and the calorimeter with a vacuum sealed insitu movement mechanism have been manufactured, tested and accepted. Most of the components of the RF beam source and the 3-grid extractor and accelerator system have been realized. During the course of manufacturing several design changes emerging from the experimental learnings from the SPIDER beam source development facility at RFX Padua have been incorporated to ensure better source performance. While the beam source is in its assembly stage, the accepted beam line components have been installed in the 9 m long 4.5 m diameter vacuum vessel with a top openable lid on the Indian test facility (INTF). The INTF is a voluntary activity with the beam source, neutralizer and ERID loaned from ITER. Such an arrangement enables DNB like beam studies over a path length of 21 m and is expected to create a database of use for diagnosticians responsible for ITER CXRS diagnostics.
In order to pursue working experience and learnings with H- beams, two test beds, single driver RF source "ROBIN"and dual driver RF source "TWIN"are currently under operation at ITER India. ITER relevant H- beams in terms of current densities > 30 mA/cm2 and electron/ion ratios < 1 have at source filling pressures of 0.3 –0.4 Pa have been realized on ROBIN. The TWIN has been used to couple powers upto 60 kW to the two drivers connected to a single RF generator in DNB like configuration. ROBIN has also been used to study the effect of confinement magnets on the plasma and beam uniformity. Recently it has been upgraded to a neutral beam line where 30 keV ~1 A neutral beams have been produced and transported to understand aspects related to neutralization, reionisation and also to establish the functionality of the first of a kind electrostatic residual ion dump concept in neutral beam lines.
The talk will cover both, the engineering and operational aspects of DNB related neutral beam activities at ITER India, IPR, with a special emphasis on learnings, results obtained and future plans.

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