DNB ION SOURCE MOVEMENT MECHANISM

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The 100 kV negative hydrogen ion source based Diagnostic Neutral Beam (DNB) injector is a part of Indian (IN) Procurement Package for ITER. DNB is expected to deliver 18- 20 A hydrogen neutral beam to the ITER plasma at a distance ~ 23m from the ion source position. The beam axis subtends a ~ 15mrad tilting angle with the tokamak machine center plane. A mechanical misalignment (> ± 2 mrad) due to mounting error in the horizontal and vertical directions is envisaged. Apart from that additional horizontal beam deflection of ~ ± 5 mrad due to the vertical tokamak stray magnetic field of value ~ ± 1G may also be present. Due to long transport length, misalignment of the ion source will cause significant transmission loss of the beam and produce asymmetric heat load on the beamline components and on the duct assembly. All these constraints call for adjustments of the ion source during DNB operation. This can be addressed by making provisions for the desired vertical and horizontal movements in the ion source support structure. The force analysis of the movement mechanism of the ion source is carried out analytically by statics and generates inputs for an engineering design of such movement mechanism.

The support system of the ion source (shown in fig.1) consists of a rigid horizontal beam, supported by two brackets welded to the side wall of the DNB vacuum vessel. The ion source is vertically suspended from the horizontal beam with the help of two vertical arms through hinge joints. Two independent translations for horizontal angular and linear misalignment adjustment are achieved by means of "master-slave" configuration. The vertical tilting and adjustment of vertical misalignment of the ion source is realized by means of a tilting mechanism, placed at the bottom of the ion source. Each movement mechanism consists of links and joints, connected to a shaft which is remotely operated from outside of the DNB vessel by a vacuum bellow sealed actuator feed through. The stroke length and actuating forces required to realize respective movements are calculated and form the basis of the engineering design of the support structure movement mechanism. The complete analysis and the design of the DNB ion source movement mechanism will be discussed in the manuscript.

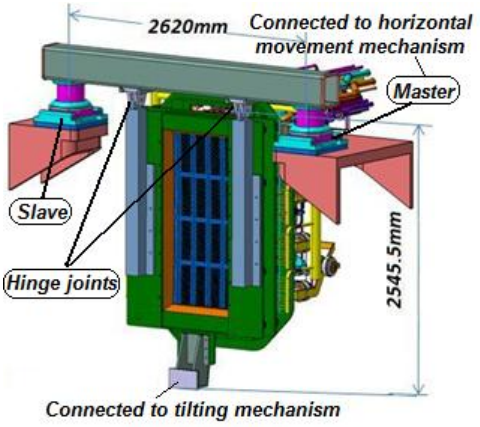

Figure 1: Support structure of DNB ion source