Design and overview of 100 kV bushing for the DNB injector of ITER

Sejal Shah[1], S. Rajesh[2], S. Nishad[3], B. Srusti[3], M. Bandyopadhyay[1], C. Rotti[1], M. J. Singh[1], G. Roopesh[1], A. K. Chakraborty[1], B. Schunke[4], R. Hemsworth[4], J. Chareyre[4], L. Svensson[4]

[1]*ITER-India, Institute for Plasma Research, Gandhinagar-382025, Gujarat, India*
[2]*Microelectronics and Materials Physics Labs, P.O.Box 4500, FIN-90014 University of Oulu, Finland*
[3]*DesignTech Systems Ltd, Banjara Hills, Hyderabad, Andhra Pradesh-500034, India*
[4] *ITER Organization, Route de Vinon, CS 90 046, 13067 St. Paul lez Durance Cedex, France*

Corresponding author: sshah@iter-india.org

The 100 kV bushing is one of the most important and technologically challenging Safety Important Class components of the Diagnostic Neutral Beam (DNB) injector of ITER. The purpose of the High Voltage Bushing (HVB) is (i) to provide the necessary electric, hydraulic and gas feed requirements of the ion source and accelerator and (ii) to form part of the primary safety barrier of ITER. The DNB bushing with a diameter of ~1.7 m and length ~1.9 m (see Fig. 1) is mounted horizontally on the rear of the DNB vacuum vessel

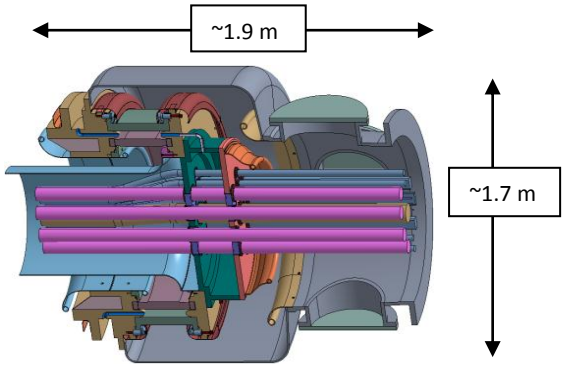

Figure 1 DNB High Voltage Bushing

A double layer vacuum shell with a continuously monitored interspace ensures vacuum compatibility and the confinement of radioactive products. The HVB vessel is filled with dry air at 0.102 MPa whereas the interspace between the two layers will be filled to 0.07 MPa with dry air. Circulation of the dry air in the interspace will avoid overheating of the dry air due to Radiation Induced Conductivity during operation.

100 kV electrical insulation is provided by a single large ceramic cylinder. The electrostatic stress on the insulator surface is limited to <15 kV/cm. Optimization of the shape of the electrostatic shields was carried out with the aim to reduce the maximum stress to <26 kV/cm in vacuum and <5 kV/cm at the triple point (the vacuum, metal, insulator junction). Special feedthroughs (ceramic-kovar©-stainless steel) are designed to provide isolation of each line passing through the HVB. The mechanical design incorporates a mechanical stress free mounting of the ceramic rings, aided by ~1.3 m diameter load bearing FRP cylinder cast onto the stainless steel flanges. Structural analyses were carried out to assess the mechanical stress distribution in the fibre reinforced plastic insulator, the alumina insulator and the integrated structure during commissioning, operation and accidental conditions. Furthermore the compatibility with the seismic classification required for ITER has been confirmed. This paper will present the design and assembly of the HVB and its compatibility with the ITER requirements.