Contribution ID: **599** Type: **Poster**

ITR/P5-43: Exploring the Engineering Performance Limits of DNB

Thursday 11 October 2012 08:30 (4 hours)

Amongst the two Neutral Beam systems for ITER, the Diagnostic Neutral Beam (DNB) system has a special operational mandate to provide a 100 keV, ~ 20 A beam to ITER, with a modulation frequency of 5 Hz having duty cycle of 3s ON –20s OFF for 3600 S. The modulation of beam is realised by the application of modulating acceleration and extraction voltage levels; thereby leading to a modulation of power density incident on the beam facing heat flux receiving components - accelerator & electron dumps system, neutraliser, residual ion dump (RID), calorimeter, exit scraper and duct liner. The design requirements have been generated taking into consideration the ITER needs and engineering design of these components has been carried out considering modulated high heat flux and the corresponding thermal hydraulic engineering. Different scenarios such as operational, test, handling, emergency and faulted conditions are considered and the analysis have been performed by FEA software- ANSYS. Both monotonic as well as cycle type structural damage verifications were performed using ITER SDC-IC. Final designs of all components have been arrived at after different stress intensities conformed to the criterion levels of SDC-IC. The BTP specifications for DNB components take into account this conformity and incorporate adequate safety margin.
While this design meets the requirements of the mandate for DNB, there is a need to assess the limits of operation of DNB in terms of the following: 1) the maximum length of time, beyond 3S for with the modulation can be sustained, 2) the maximum pulse length for which the beam can be operated without modulation. These inputs will help CXRS, BES diagnosticians to design their diagnostic setup for the maximum level of performance.
The performance characterisation of DNB to be carried out in the Indian-Test Facility (INTF), which include provisions to tests those above mentioned limits.
The paper presents the results of assessments that have been carried out and provides recommendations for the maximum operation limits.

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Session Classification: Poster: P5

Track Classification: ITR - ITER Activities