Status of the Negative Ion Based Heating and Diagnostic Neutral Beams for ITER

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The current baseline of ITER foresees 2 Heating Neutral Beam (HNB's) systems based on negative ion technology, each accelerating to 1 MeV 40 A of D^- and capable of delivering 16.5 MW of D^0 to the ITER plasma, with a 3rd HNB injector foreseen as an upgrade option [1]. In addition a dedicated Diagnostic Neutral Beam (DNB) accelerating 60 A of H^- to 100 keV will inject ≈15 A equivalent of H^0 for the CXRS and MSE diagnostics. Recently the RF driven negative ion source developed by IPP Garching has replaced the filamented ion source as the reference ITER design. The RF source developed at IPP, which is approximately a quarter scale of the source needed for ITER, has demonstrated reduced caesium consumption, adequate accelerated D^- and H^- current densities as well as long-pulse operation [2, 3]. It is foreseen that the HNB's and the DNB will use the same negative ion source. Experiments with a half ITER-size ion source are on-going at IPP and the operation of a full-scale ion source will be demonstrated, at full power and pulse length, in the dedicated Ion Source Test Bed (ISTF), which will be part of the Neutral Beam Test Facility (NBTF), in Padua, Italy. This facility will carry out the necessary R&D for the HNB's for ITER and demonstrate operation of the full-scale HNB beamline. An overview of the current status of the NB systems and the chosen configuration will be given and the ongoing integration effort into the ITER plant will be highlighted. It will be demonstrated how installation and maintenance logistics have influenced the design, notably the top access scheme facilitating access for maintenance and installation. The impact of the ITER design review and recent design change requests will be briefly discussed, including start-up and commissioning issues. The low current hydrogen phase now envisaged imposes specific requirements for operating the HNB's, either by addressing the shinethrough problem via the installation of beam dumps or by modifying and operating the HNB's at 500 keV. Other NB related issues identified by the design review process will be discussed and the possible changes to the ITER baseline indicated.

[1] ITER PID, https://users.iter.org/users/idm?document_id=ITER_D_2234RH
[2] SPETH, E., et. al, Nucl. Fusion **46**, (2006) 220
[3] W KRAUS, et. al., Rev. Sci. Instrum. **79**, 02C108 (2008)5

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