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OVERVIEW OF THE JET NEUTRAL BEAM ENHANCEMENT PROJECT (O2A-B-453)

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Three objectives of the JET Neutral Beam Enhancement (NBE) are a) to increase the NB power delivered to JET from 25MW to >34MW; b) to extend the beam pulse duration from 10 to 20 seconds and c) to improve availability and reliability of the JET NB system. The project is based on the upgrade of the two existing JET neutral injectors, each equipped with eight positive ion neutral injectors (PINIs).

The main increase of the NB power will come from the rearrangement of the ion source permanent magnets from the present supercusp to pure chequerboard configuration, thus eliminating the magnetic filter used to limit primary electrons reaching the extraction region. This modification considerably increases the fraction of molecular ions, which leads to higher neutralisation efficiency. Further increase in the injected neutral beam power will result from higher beam transmission, the consequence of high uniformity and superior properties of the beams extracted from chequerboard ion sources. Finally, the maximum extracted deuterium ion current will be increased from the present ~55A to ~65A. This will be accomplished by the minor modification of the extraction aperture diameter and the accelerator gap. All PINIs will be operated at the same acceleration voltage (125kV).

The increase of the beam pulse length from 10 to 20 seconds requires modification or replacement of inter-pulse water cooled beamline components. The most challenging among these tasks is the replacement the duct liner, which protects the vessel from re-ionised beam power at the beam entry into the torus. It will be replaced with an actively cooled liner based on proven hypervapotron technology.

To improve the overall reliability of the JET neutral beam system and to allow extraction of 65A of deuterium ion current, eight existing 80kV/60A high voltage power supplies (HVPS) will be replaced with four new 130kV/130A units. This means that, after the completion of the NBE project, 75% of the JET NB system (12 out of 16 PINIs) will be operated using modern HVPS units based on Isolated Gate Bipolar Transistor (IGBT) switching technology.

The NBE project is one of the largest modifications of the JET machine under EFDA management and is being carried out by the UKAEA Fusion Association. The project started in 2005 and will be completed in 2009. The various physics, engineering and planning issues related to the NBE project will be discussed in the paper.