TITLE

Modeling and experimental studies of the DIII-D neutral beam system

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The Neutral Beam system on DIII-D consists of eight ion sources on four beamlines. The basis of the system is the Common Long Pulse Source (CLPS). Essentially the CLPS is an 80 kV high perveance, deuterium positive ion based system delivering up to 2.5 MW per source. The ion source is a filament driven magnetic bucket design and the accelerator is a slot and rail tetrode design with vertical focusing achieved through tilted grids.

There are a number of proposals to build on the recent very successful DIII-D off-axis neutral beam (OANB) upgrade that involved tilting a beamline to provide off-axis current drive. One future upgrade proposal includes increasing the injected power and energy by extending the beam pulse length and increasing the beam voltage. Another proposal is to reconfigure one beamline to give it the capability of co- and counter-injection as well as off-axis injection.

In this paper we present the results of beam physics experimental and modeling efforts aimed at learning from and building on the experience of the DIII-D OANB upgrade and other NB system upgrades such as those at JET. The modeling effort includes electrostatic accelerator modeling (using a Poisson solver), gas dynamics modeling for the neutralizer and beam transport models for the beamline. Experimentally, spectroscopic and calorimetric techniques are used to evaluate the system performance. We seek to understand and ameliorate problems such as anomalous power deposition, originating from misdirected or excessively divergent beam particles, on a number of beamline components. We qualitatively and quantitatively evaluate possible project risks such as neutralization efficiency deficit and high voltage hold off associated with increasing the beam energy up to 105 keV.

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