SCHEMES AND OPTIMIZATION OF GAS FLOWING INTO THE ION SOURCE AND THE NEUTRALIZER OF THE DIII–D NEUTRAL BEAM SYSTEMS*

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Performance comparisons of a DIII–D neutral beam ion source operated with two different schemes of supplying neutral gas to the arc chamber were performed. Superior performance was achieved when optimized gas flows were puffed into both the arc chamber and neutralizer as compared to supplying gas through the neutralizer alone. To form a neutral beam, ions extracted from the arc chamber and accelerated are passed through a neutralizing cell of gas. Neutral gas is commonly puffed into the neutralizing cell to supplement the residual neutral gas from the arc chamber to obtain maximum neutralization efficiency. However, maximizing neutralization efficiency does not necessarily provide the maximum available neutral beam power, since high level of neutral gas can increase beam loss through collisions and cause larger beam divergence. Excessive gas diffused from the neutralizer into the accelerator region also increases the number of energetic particles (ions and secondary electrons from the accelerator grid surfaces) deposited on the accelerator grids, increasing the possibility of overheating. We have operated an ion source with a constant optimal gas flow directly into the arc chamber while gas flow into the neutralizer was varied. Neutral beam power available for injecting into plasmas was obtained based on the measured data of beam energy, beam current, beam transmission, beam divergence, and neutralization efficiency for various neutralizer gas flow rates. We will present the results of performance comparison with the two gas puffing schemes, and show steps of obtaining the available beam power and determining the optimum neutralizer gas flow rate.

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