

A negative ion-based neutral beam injector comprising a negative ion source, accelerator and neutralizer to produce about a 5 MW neutral beam with energy of about 0.50 to 1.0 MeV. The ions produced by the ion source are pre-accelerated before injection into a high energy accelerator by an electrostatic multi-aperture grid pre-accelerator, which is used to extract ion beams from the plasma and accelerate to some fraction of the required beam energy. The beam from the ion source passes through a pair of deflecting magnets, which enable the beam to shift off axis before entering the high energy accelerator. After acceleration to full energy, the beam enters the neutralizer where it is partially converted into a neutral beam. The remaining ion species are separated by a magnet and directed into electrostatic energy converters. The neutral beam passes through a gate valve and enters a plasma chamber.