

Performance of Beam Extractions for the KSTAR Neutral Beam Injector

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The first neutral beam injector (NBI-1) has been developed for the Korea Superconducting Tokamak Advanced Research (KSTAR) tokamak. A first long pulse ion source (LPIS-1) has been installed on the NBI-1 for an auxiliary heating and current drive of KSTAR core plasmas. Performance of ion and neutral beam extractions in the LPIS-1 was investigated initially on the KSTAR NBI-1 system, prior to the neutral beam injection into the main plasmas. The ion source consists of a JAEA magnetic bucket plasma generator with multi-pole cusp fields and a set of KAERI prototype-III tetrode accelerators with circular apertures. The inner volume of plasma generator and accelerator column in the LPIS-1 is approximately 123 liters. Final design requirements for the ion source were a 120 kV/ 65 A deuterium beam and a 300 s pulse length. The extraction of ion beams was initiated by the formation of arc plasmas in the LPIS-1, called as an arc-beam extraction method. A stable ion beam extraction of LPIS-1 has been achieved up to an 100 kV/42 A for a 4 s pulse length and an 80 kV/25 A for a 14 s pulse length. Optimum beam perveance of 1.21 microperv has been found at an accelerating voltage of 80 kV. Neutralization efficiency has been measured by using a water flow calorimetry (WFC) method of calorimeter and an operation of bending magnet. The full-energy species of ion beams have been detected by using the diagnostic method of optical multichannel analyzer (OMA). An arc efficiency of the LPIS was 0.6~1.1 A/kW depending on the operating conditions of arc discharge.

Keywords: neutral beam injector, KSTAR, long pulse ion source, optimum beam perveance, neutralization efficiency, arc efficiency