

§1. Performance of Neutral Beam Injection Systems in the 9th Campaign

Takeiri, Y., Kaneko, O., Oka, Y., Tsumori, K., Osakabe, M., Ikeda, K., Nagaoka, K., Asano, E., Kondo, T., Sato, M., Shibuya, M., Komada, S.

The LHD is equipped with three negative-ion-based neutral beam injectors (NBI) --- BL1, BL2, and BL3. In the 9th campaign, a positive-ion-based NB injector, named BL4, has been newly constructed and installed for a diagnostic of the charge-exchange spectroscopy and a plasma control. The positive-NBI was designed to inject 40keV-3MW hydrogen beam with two positive ion sources. Arrangement of the NB injectors is shown in Fig. 1. BL4 injects low-energy beams perpendicularly to the magnetic axis, while the negative-NBI systems of BL1, BL2 and BL3 inject high-energy beams tangentially.

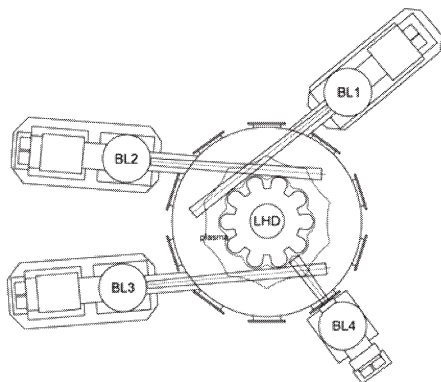


Fig. 1. Arrangement of the neutral beam injectors.

The construction of BL4 was completed in September, 2005, and the injection started successfully at the first experimental day of the 9th campaign (October 4). After the first injection, the injection power of BL4 was rapidly increased, and the specified injection energy and power of 40keV-3MW was achieved in three weeks.

As for the negative-NBI systems, the injection histories in the 9th campaign are shown in Figs. 2 and 3, for the total port-through injection power and the individual injection powers of three injectors, respectively. The maximum total injection power was 11.9MW, and high-power beams of more than 10MW were injected reliably for many LHD plasma shots.

BL1, which has already achieved a high-power injection of 184keV-5.7MW using the ion sources with multi-slotted grounded grid, had a trouble of water leak from the grounded grid. The arc and filament power supplies had also a trouble with thyristors by the high-voltage surge. Although the BL1 operation was restricted to an extent due to the above troubles, stable injection of 4-5 MW was carried out.

The grounded grid of the ion sources in BL2 has multi-round apertures, and the aperture diameter was enlarged in the 9th campaign for reduction of the grid heat load. As a result, the injection energy was increased above

170keV and the maximum injection power was increased to 4.2MW. Although the operation was not enabled for two weeks due to a trouble with a motor of the water pump, reliable injection of 3-4MW was carried out.

In BL3, there is no trouble in the operation during the campaign. However, the injection energy was not raised and remained at less than 160keV. No definite cause was found on inspection inside the accelerator after the campaign. Although stable injection was carried out, the injection power was around 3MW.

In the next campaign, a new grid system is planned to increase the injection power in BL1, and by improving the accelerator the injection power will be recovered in BL3. Therefore, the total injection power is expected to be much increased in the next campaign.

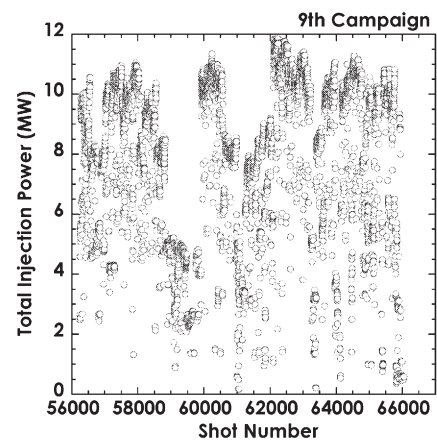


Fig. 2. History of the total injection power in the 9th campaign.

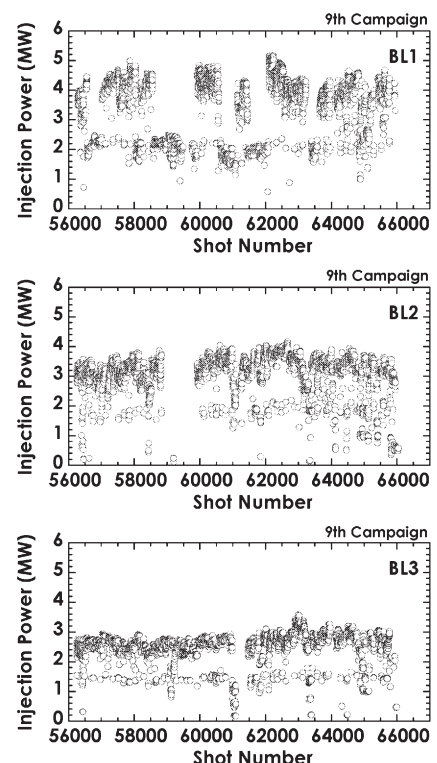


Fig. 3. History of the injection power of the individual injectors of BL1, BL2, and BL3.