§44. Design Study of NBI Armor

Komori, A., Ohyabu, N., Takeiri, Y., Inoue, N., Yonezu, H., Osakabe, M.

Design study of NBI armor has been done to protect the LHD vacuum vessel from the heat load of shine-through neutral beam particles. Three distinct modes of operation are planned to be performed with the NBI, depending on the density of target plasma and the duration of the NBI. The maximum heat flux on the NBI armor is 150 W/cm^2 in the short pulse operation. The design of the NBI armor is, however, determined by the low heat flux in the long pulse operation. The maximum duration of the NBI is expected to be 1,800 sec with the input power of 3 MW.

The area of the vacuum vessel, where the shine-through neutral beam particles strike, can be obtained with the help of a CAD system. Figure 1 shows the neutral beams whose heat flux is higher than 100 W/cm^2. The neutral beams are shown to graze the vacuum vessel near the tangential ports for the NBI, and to strike the vacuum vessel facing the tangential ports. The NBI armor has been designed to cover these areas with the heat flux higher than 100 W/cm^2 on the condition that the target plasma does not exist.

Figure 2 shows the NBI armor thus designed, whose size is about 1,500 × 1,580 mm in the front view. The NBI armor is formed planar plates, although ideally they should be three-dimensional curved ones which match the vacuum vessel. Each plate consists of carbon tiles and a water-cooled stainless-steel heat sink. The size of the carbon tile is 100 × 100 mm, and the thickness is 30 mm. The mechanical joint is used between the carbon tile and heat sink. Of course, the carbon tiles face the neutral beams.

Design works of an interlock system to avoid injecting the neutral beam without the target plasma and a measuring system for the armor temperature are under way.

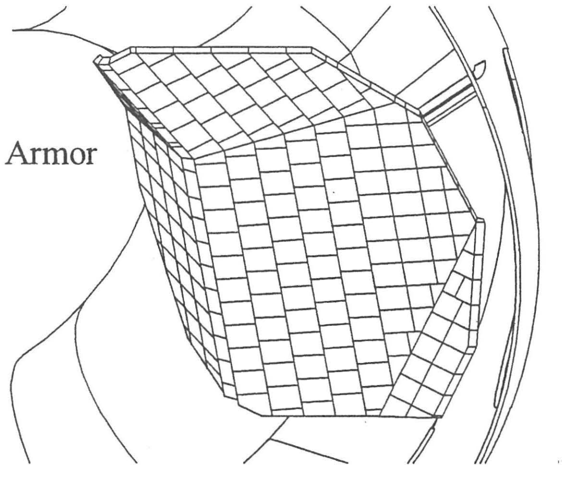

Fig. 2. NBI armor.

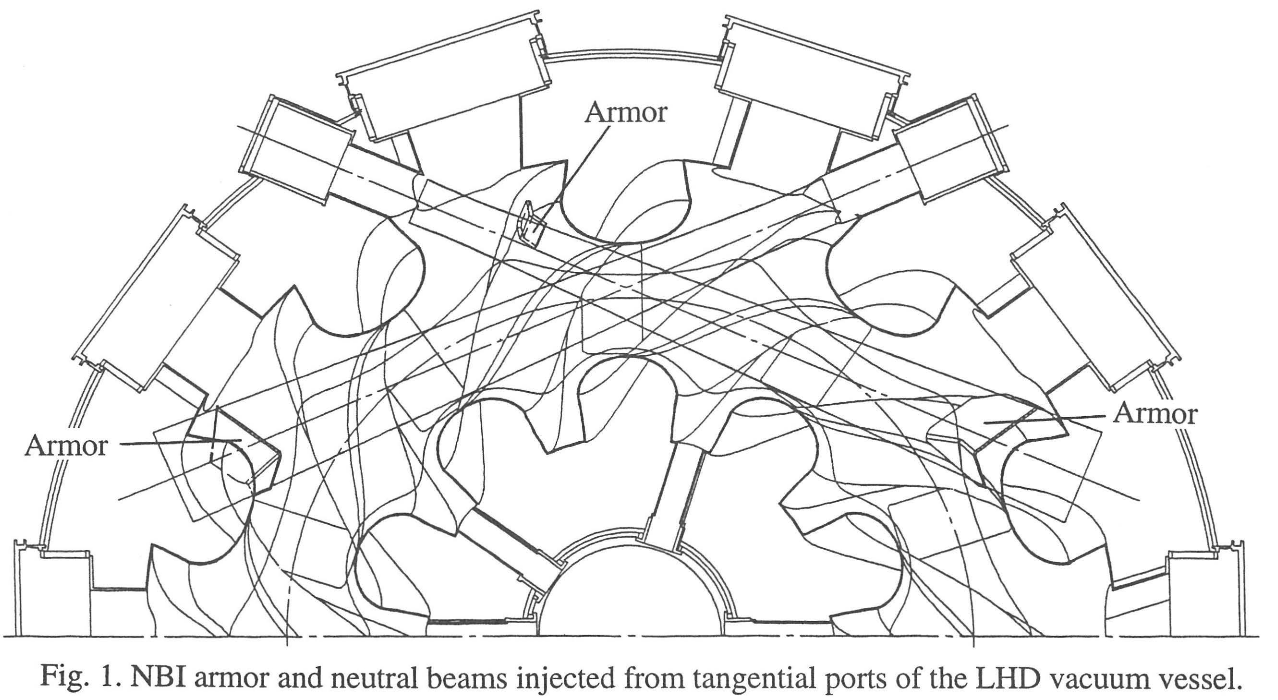

Fig. 1. NBI armor and neutral beams injected from tangential ports of the LHD vacuum vessel.