§57. Design and its Optimization of Closed Divertor for QUEST

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"Research and development of the divertor adjusted for the characteristic magnetic configuration of spherical tokamaks (STs), and establishment of the particles and heat load control methods with divertor configuration in long pulse operation" are important for the steady-state operation of ST, and one of main objects for QUEST project. To achieve them, the modifications of closed-divertor configuration such as the geometry of dome and slope of divertor plates are required against standard magnetic configuration. For this purpose, the concepts of the divertor designing for QUEST should be cleared with the help of divertor simulation code SOLDOR developed at Japan Atomic Energy Agency.

The structure of divertor part and mesh used in calculation are shown in Fig. 1. The UFC253 port and ICF356 port are mounted as the pumping ports on inner-bottom side and outer-bottom side, respectively. Fig. 2 shows the electron temperature profile of divertor parts in standard magnetic configuration.

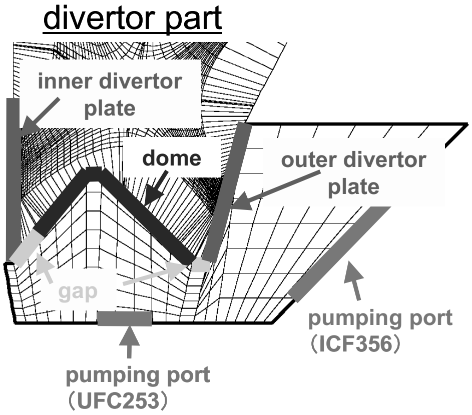

Fig. 1. Concept design of QUEST divertor and mesh geometry

In the QUEST project, the tungsten plates are planned to be installed as the divertor plate. Although the heat load material tests had been executed with CVD tungsten plates at $5MW/m^2$ (steady) and $20MW/m^2$ (pulse)[1)], the plasma heating power will be increased up to 1MW in steady state operation and 3MW in pulse operation in future plan of QUEST. Thus, the evaluations of heat loads to divertor plats and its profiles are required. The actively-heated first-wall to high temperature around 300-500 degrees C will also be installed to QUEST in future for the long pulse operation with recycling ratio of hydrogen set to just about 1. Because of this, the evaluations of dependencies of the divertor geometry and magnetic configuration to pumping throughput are also required to equip the high pumping capability to pump almost all particles from plasma core. In this report, the comparison of the effectiveness of inner-bottom side and outer-bottom side pumping ports is described.

All pumping speed at divertor part of QUEST is estimated as $25m^3/sec$ considering conductance of pumping port size and length. The pump throughput changing the ratio of pumping speeds between inner and outer pumping port with a condition of all pumping speed kept constant is shown in Fig. 3. (The left side of x-axis means that 100% ($25m^3/sec$) of pumping speed is assigned to inner pumping port and vice versa.) The pump throughput is improved with the increase of the ratio of inside pumping speed against gas puffing of $1.0x10^{21}$ 1/sec. Thus, with this divertor geometry and magnetic configuration, the higher assignment of pumping capability to the inner pumping port will be better for the sustaining steady state condition. In the future, the further modifications of divertor configuration such as the location and geometry of dome and slope of divert plates will be done.

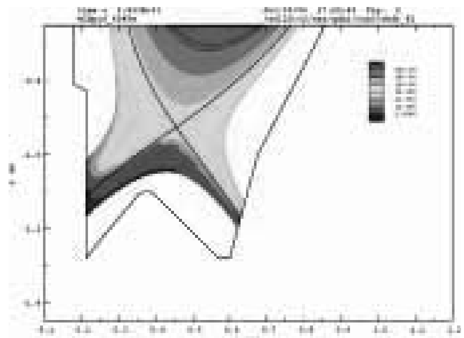

Fig. 2. Electron temperature profile of standard magnetic configuration.

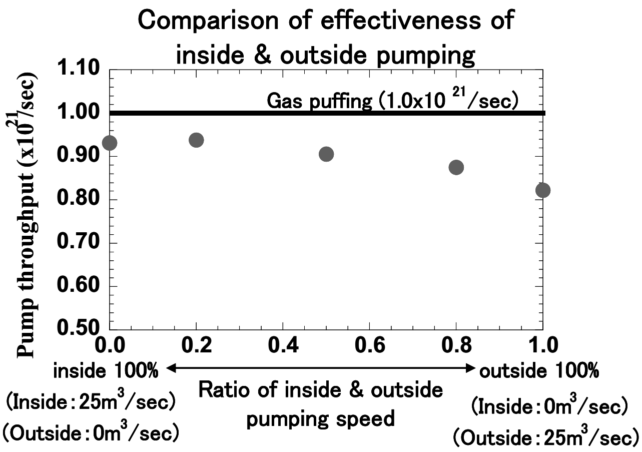

Fig. 3. Dependency of pumping capability to inside-outside pumping ports.

1) J.Boscany, et al.: Fusion Eng. Des. **39-40** (1998) 537-542