Design, Fabrication and Performance Test of JT-60 Structural and Thermal Aspects

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JT-60 is a large tokamak experimental device constructed at JAERI with main device parameters of $R=3.0$ m, $a=0.95$ m, $B_t=45$ kG, and $I_p=2.7$ MA. Its basic aim is to produce and confine hydrogen plasmas of temperatures in a multi-keV range and of confinement times comparable to a second, and to study its plasma physics properties as well as engineering problems associated with them.

The JT-60 tokamak machine is mainly composed of a vacuum vessel, toroidal field (TF) coils poloidal field (PF) coils, and support structures.

The vacuum vessel is a high vacuum toroidal chamber with an egg-shaped crosssection, consisting of sectorial rigid rings and parallel bellows made from Inconel 625. It is baked out at a maximum temperature up to 500°C , and its ultimate vacuum is less than 1.3×10^{-6} Pa. After these specification were achieved at the factory, vacuum vessel was transferred to the site. The highest stress of the vacuum vessel is caused by the magnetic force in the plasma disruption. It is confirmed by the calculation analysis that the stress is sufficiently smaller than the allowable stress of Inconel 625. Several kinds, about ten thousand pieces of first walls are bolt-jointed to the vacuum vessel for the protection of the vacuum vessel and many sensors. The maximum heat load is about 4 KW/cm^2 . The material of the first wall is molybdenum for the higher heat load area and Inconel 625 for the lower heat load area, respectively. First walls are highly stressed by the electromagnetic force and thermal load, are coated by TiC from the view point of impurities.

The performance of the baking and vacuum of the vacuum vessel was verified till the end of September 1984.

The TF coil system consists of 18 unit coils located around a torus axis at regular intervals. The unit coil is wedge-shaped at the section close to a center column and encased in a high-manganese non-magnetic

steel case. The conductor and case of the wedge-shaped part were extremely stressed by the magnetic force and the temperature rise. The thermal and mechanical performance were tested and confirmed in the factory.

The PF coils are composed of ohmic heating coils, vertical field coils, horizontal field coils, and quadrupole field coils located inside the TF coil bore and outside the vacuum vessel, and magnetic limiter coils placed in the vacuum vessel. The stress of these is very large and almost near the allowable stress of the conductor reinforced by cold-press etc. It is mainly because of the space limit by the placement of each component required from physical meaning. The PF coils have many welded-joints at the side so it takes much time for its assembling and testing.

The assembling of the machine was started in February 1983 by the base support structure, and continued to October 1984. Then several kinds of performance test were carried out and will be finished in March 1985.

In last December, the rated current of 52.1 kA of the toroidal field coil was attained, and in this February, the full power test for all kinds of coils was achieved successfully.

The first plasma is expected to be produced in this April.