DETAILED DESIGN STUDIES AT CEA FOR JT-60SA TF COILS

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Following a first conceptual design activity in which the general design of the JT-60SA TF system was defined and frozen in agreement with all the participants in the project (CEA, ENEA, F4E), a second phase had to be launched to deal with the detailed design. In this paper, we present the work performed at CEA on the TF coil design during this second phase. This work, which is still ongoing, has been concerned with refined modelling, improvement of design with regard to manufacturing, and fabrication and tests of preliminary mock-ups.

The main two critical parts in the TF coil winding are the helium inlets and the inner electrical joints and coil terminations. The helium inlets are located on the inner side of each double pancake in the coil whereas the outlets are located in the electrical joints (outer side of the coil) and in the terminals. One major issue with the inlet/outlet is the pressure drop which should remain low compared to the whole pressure drop along the hydraulic length of one pancake. The first tests on preliminary helium inlet mock-ups have led CEA to reject the simple original design and to propose an improved design validated by pressure drop measurements performed at Nitrogen gas as well as with liquid water in the CEA test facilities. Mechanical modelling and mock-up testing are still to be carried out to fully validate this design.

Pressure drop through outlets are estimated to be negligible from already existing validated models, but experimental confirmation is still needed. In order to eliminate the helium inlets, computation using thermohydraulic models have been launched to estimate the effect of helium injection at an electrical joint (with the outlet at the next joint), thus feeding one whole double pancake in series. The results have shown that the increase of the operating temperature at peak magnetic field in the conductor was then too high to keep the temperature margin above the design value of 1 K.

On the other hand, the inner electrical joints of the coil have been modified with respect to the original twin-box design developed by CEA for the ITER coils in order to simplify the fabrication process.