Dynamic modeling of the cooling circuits of superconducting magnets for the Japanese tokamak JT-60SA

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PhD may follow: No

Summary :

The CEA Grenoble Low Temperature Laboratory (SBT) is widely involved on cryogenic system design for the future superconducting tokamak JT60-SA. This tokamak is built in Japan and shall operate in 2019. The cryogenic system is under design phase by the industrial and CEA is responsible for the follow up of the contract. The commissioning of the cryogenic system is foreseen in 2016.

The cryogenic system dedicated mainly to cool down the superconducting magnets, is affected by the important variable thermal heat loads, resulting from the cycling plasma operation. The process of the cryogenic system shall take into account the mitigation of the variable loads. Dynamic simulations become of interest to assess and validate the operations under pulsed loads scenarios.

Experimental work at SBT on scale down loop has shown the effects of pulsed heat loads on supercritical helium loop under several configurations. The thermohydraulic evolutions can affect the cryogenic components such as the cold circulator. Dynamic simulations have already been validated on the test-facility, using Ecosimpro with the Cryolib library.

This internship research includes numerical works in the cryogenic field. The main task is to model the cryogenic system of JT-60SA, taking into account the refrigerator and auxiliary cold box.

Full description :

. After a modelling of the cryogenic system of JT-60SA, with the input data of the industrial, dynamic simulations would be performed to study different scenarios:

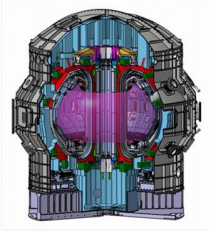
• Acceptance test scenarios with variable loads on the cryogenic system without the connection to the cryogenic users.

• Nominal operation with variable loads on the cryogenic system with the helium circuits of the cryogenic users.

• Abnormal scenario such as fast discharge scenario.

These simulations would be important to prepare and specify the acceptance tests of the cryogenic system foreseen in 2016. Indeed the acceptance tests shall be representative of the nominal operation with the cryogenics users. The reduced helium volume in the acceptance test will affect the thermohydraulic evolutions and dedicated tests shall be specified to have a good representative of the operation of the system with the total helium inventory. The resulting model aims at developing a simulator that can be used for preparing the operation of the cryogenic system, such as the nominal operation and the abnormal scenarios.

It will require from the candidate competences in thermo-hydraulics and numerical analyses. The research topic demands rigorous scientific approach, good organisation skills to collect all the technical data for the modelling.



Tokamak Japonais JT-60SA

Boucle expérimentale HELIOS du SBT

Requested skills :

thermohydraulics, fluid mechanics, numerical analyses, control process