DRF: Thesis SL-DRF-20-0513

RESEARCH FIELD

Thermal energy, combustion, flows / Sciences pour l'ingénieur

TITLE

Thermohydraulic Analysis and Model of Tokamak Superconducting Magnets Operation and Quench

ABSTRACT

The cryomagnetic system of a tokamak is constituted of a cryogenic system and of superconducting magnets (Cable-In-Conduit-Conductor, CICC, stored energy up to 40 GJ), cooled by helium forced flow at around 5 K. This PhD will focus on the analysis and model of normal operation (slow transients: plasma scenarios, disruption, current discharge) and quench incidents (resistive transition, fast thermohydraulic transient), their detection and impact (security objective). This study will be applied to JT-60SA Japanese tokamak, for which a model of the whole cryomagnetic system will allow specifying the operation domain and providing recommendations for quench detection (primary upon electrical signals and secondary upon thermohydraulic signals), with possible extrapolation to ITER magnets. These models will be performed with SuperMagnet (CryoSoft) and SimCryogenics (IRIG) codes. These results will be validated by means of comparisons with experimental data of tests performed at IRFU on JT60-SA toroidal coils. Experiments will be performed for the assessment of heat exchange coefficient in CICC and cooling channels of coils thick casing. This PhD, co-directed with IUSTI of Marseille, will be led in collaboration with IRIG and IRFU institutes of CEA/DRF and WPUT (Poland) and with an industrial partnership, ASSYSTEM.

LOCATION

Institut de recherche sur la fusion par confinement magnétique
Service Tokamak Exploitation et Pilotage
CRYomagnétisme
Place: Cadarache
Start date of the thesis: 01/09/2020

CONTACT PERSON

Sylvie NICOLLET
CEA
DRF/IRFM/STEP/CRYomagnétisme
CEA/Cadarache
Phone number: +33 4 42 25 49 79
Email: nicollet@drfc.cad.cea.fr

UNIVERSITY / GRADUATE SCHOOL

Aix-Marseille Université
Sciences pour l'Ingénieur : Mécanique, Physique, Micro et Nanoélectronique - Aix-Marseille Université -

THESIS SUPERVISOR

Frédéric TOPIN
Université Aix-Marseille
IUSTI - CNRS UMR 6595
5, rue Enrico Fermi - Technopôle de Château Gombert - 13453