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# P3.077 ANALYSIS OF TORE SUPRA/WEST TOROIDAL FIELD COIL QUENCH AND THERMO-HYDRAULIC MODEL WITH SUPERMAGNET

*Wednesday, 19 September 2018 11:00 (2 hours)*

The Toroidal Field (TF) system of the Tore Supra/WEST tokamak comprises 18 NbTi superconducting coils, cooled by a static superfluid helium bath at 1.8 K and carrying a nominal current of 1255 A. The 19th December 2017, at the end of plasma run #52205, the current Fast Safety Discharge (FSD) was triggered after a quench of TFC-09.

A numerical model has been developed with SuperMagnet (CryoSoft). The whole TFC-09 circular coil is modelled by THEA as a single big Cable-In-Conduit Conductor (CICC) with 2028 big rectangular strands (monolithic conductors of length equal to coil average perimeter). The external quench helium relief circuit (cold and warm safety valves, rupture disk and magnetic valve with corresponding pressure set) is modelled by FLOWER.

The paper compares the calculated results and measured signals during TFC-09 quench, with focus on 3 main important parameters:

1) the Minimum Quench Energy (MQE) calculated in THEA with small initial heat deposition length (few tens of centimeters) at low field region (external leg) which is compared to the real shape and energy of neutron and gamma flux caused by highly energetic runaway electrons colliding the outboard plasma facing components. This energy is found to be in the order of few kJ.

2) the calculated expulsed helium mass flow through cold safety valve compared to the measured one. The whole initial helium mass of 34 kg is expulsed in nearly 5 s giving a mass flow of nearly 6 kg/s.

3) the helium pressure in the coil, upstream of cold safety valve, with a maximum value of nearly 9 bar.

This event confirms the criticality and the possible occurence of a so called “smooth quench” caused by small initial heat deposition length and at low field region which can be useful for other Tokamak magnets quench studies and safe operation.

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