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Experimental evaluation of computer-aided quench detection for the KSTAR CS Coil

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The KSTAR CS coil needs an active quench detection system, where the primary one is the resistive voltage detection. The system should operate with two basic requirements, which are almost infallible quench detection and minimization of fake quench alarms. However, the inductive voltage, which is generally much higher than the resistive voltage caused by quench, can trigger the fake quench alarm frequently if it is not properly compensated. Co-wound Voltage Tapes (CVT) and bridge circuits are used to reduce such inductive voltage. However, they do not perfectly cancel out the inductive voltage due to mutual inductances between coils. In order to effectively compensate the inductive voltage, all inductances between coils should be considered, where the real quench detection voltage is made by subtracting all inductive voltage components of the other coils from the measured voltage of a coil. By taking all the complexity into account, its implementation can be done only by a microprocessor. The computer-aided quench detection system was designed and tested for the KSTAR PF 1 coil. In this paper, the design of di/dt measurement devices and pre-compensation circuits are presented with the test results carried out in 2016 KSTAR campaign. The design considering plasma dynamics is suggested to further reduce the inductive voltages caused by plasma.

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