



Contribution ID: 366

Type: **Poster Presentation of 1h45m**

Locating Electrical Faults in Superconducting Accelerator Magnets

Thursday 31 August 2017 13:45 (1h 45m)

Identifying the location of an electrical fault (mainly short-circuit or circuit break) in close systems like superconducting magnet is very difficult especially when a problem appears only at cold conditions (no resistance). The Time Domain Reflectometry (TDR) method could be useful notwithstanding that there is commonly known limitation on the use of TDR to test the inductive circuit results of the high attenuation of incident and reflected pulses. The paper describes a method for locating electrical faults in superconducting magnets by means of measurements of the pulse response of magnet coil circuits (TDR principle). Due to adapting TDR to test a circuit characterized by high values of equivalent capacitance and inductance, which is a winding of superconducting magnet, a study of the relationship between the frequency response of magnets and the injected pulse transient parameters is presented. The cut-off frequency of the investigated circuit is the crucial information for the pulse shaping. A TDR reflectometer with a pulse shaping circuit which has been developed is described. The instrument consists of commonly available laboratory measuring equipment: pulse generator and 50MHz oscilloscope, which significantly facilitates performance of the measurements. Test measurements were carried out for both the undamaged magnets and the magnets with various locations of coil shorts. Advantages and limitations of the proposed method are discussed.

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Session Classification: Thu-Af-Po4.11

Track Classification: G8 - Novel Diagnostics and Other Techniques