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[Invited] Preliminary tests 12 T REBCO isolated solenoid magnet used as compact 1 MJ SMES.

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A 12 T REBCO solenoid with a 192 mm wide inner bore tapes was designed in the framework of the BOSSE Project, using 12 mm-wide isolated tape as conductor. This 814 mm high coil can be used as a compact 1 MJ –2 MW inductive energy storage, with an 850 A rated current. One of the objectives was to overcome the present record of mass energy density, held by a NbTi coil (13 kJ/kg), and reach 20 kJ/kg of self-supporting winding.

This solenoid is composed of 21 double-pancakes with a soldered inner joint. The successful test of a first full scale prototype double-pancakes reached its limiting critical current (972 A) in standalone with no damage. This result was possible thanks to a sensitive (100 µV range) quench detection system. This prototype was also tested up to 625 A under background field up to 6 T in a resistive large bore magnet, in order to validate the mechanical design, reaching 400 MPa.

Our approach to safely operate this magnet in spite of the high operating current density (530 A/mm²) is to protect each double-pancakes independently. Several partial assemblies are currently being tested in order to configure and validate the simultaneous protection of a growing number of double-pancakes. During these tests, the transient voltage is carefully monitored to detect dissipation. The various phenomena contributing to this transient voltage will be discussed with the help of detailed electromagnetic modelling results. We will present here the results of these tests for stacks of 3 and 5 double pancakes, in terms of energy storage and efficiency for the future use of the coil as energy storage. We will also present the results of field linearity and stability and discuss them for the use of single tape isolated REBCO coils as ultra-compact high field magnets.

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