Measurement of thermomechanical properties of 400 kV 2500 mm^2 cable

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Knowledge of the thermomechanical properties of cable systems is vital in designing efficient cable support structures, which will be able to withstand the forces exerted by the cable system but with minimum cost. In order to better understand the forces produced by large 400 kV cables with 2500 mm^2 conductors, a series of laboratory tests has been commissioned. This paper provides a summary of the tests conducted and the key results obtained.

The tests were carried out on a specially designed test rig (see Figure 1), which was adaptable to a number of different tests. The main test series involved the determination of the thermal expansion coefficient and the axial force generated by this thermal expansion. Data was obtained for both a fast ramp rate (intended to minimize conductor relaxation during the test), under cyclic heating and with a very slow logarithmic temperature rise. This provides a range of expected axial forces, with the fast ramp rate test providing the worst case value (highest force). Temperature control was achieved through the use of ac current in the conductor and sheath, with the currents being controlled to provide a suitable temperature gradient across the cable. Thermocouples were installed in the cable along itself length to allow the temperature profile to be evaluated.

In addition to the main axial force measurements, the design of the rig also permitted the bending stiffness and torsional stiffness of the cable to be evaluated at a range of temperatures. The results gained have proved valuable in quantifying the thermomechanical behaviour of such cable systems, allowing new guidance to be provided on the forces which must supporting steelwork must withstand.

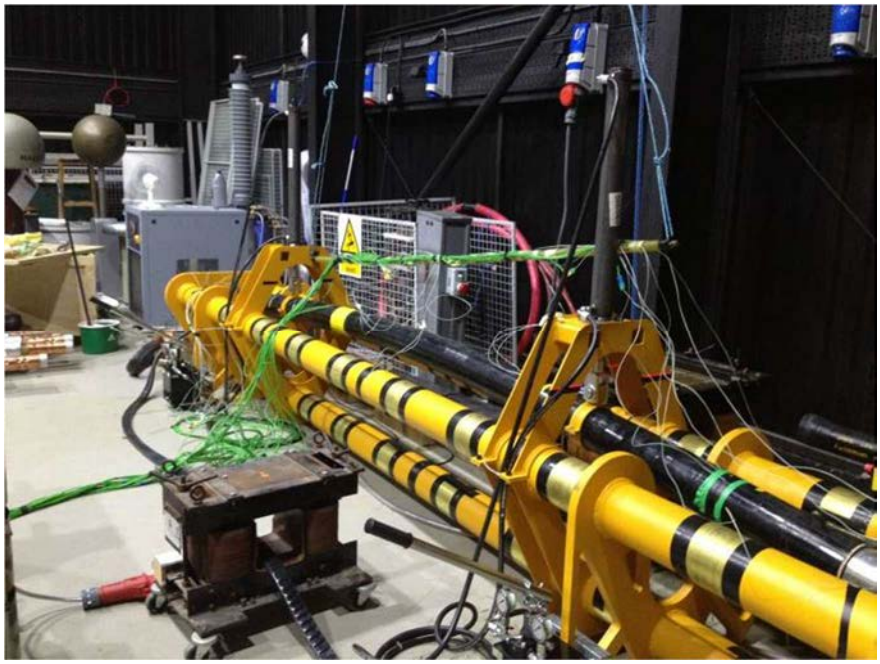

Figure 1 – Test rig in operation for bending test