Automated temperature monitoring and control system for type and design testing of high voltage XLPE insulated cable systems

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Polymeric insulated underground power cables are steadily replacing the oil and paper insulated cables to the extent that nowadays for the vast majority of the new cable system installations the only considered cable designs are the XLPE insulated cables.

Some of the required electrical type or design tests as per as IEC and ANSI/ICEA involve testing of the cable system at particular conductor temperature while the system is energized at High Voltage. In order to do that, in the standards, it is suggested to arrange a “dummy” cable loop that is heated in the same manner as the test loop, but not energized at High Voltage. In such configuration it is easy to connect thermocouples directly onto the “dummy” cable loop conductor and monitor its temperature. Since the magnitude of the heating current in the “dummy” loop is exactly the same as the magnitude of the current flowing in the test loop, the conductor temperature of the test loop is assumed to be equal to the conductor temperature of the “dummy” loop. This method of temperature measuring is straight forward and used at many test facilities. However, the test loops for High Voltage cable systems of 150kV and above require larger clearances and occupy a significant footprint, which means that test setup arrangements including a test loop and a “dummy” loop could only fit in very large test halls.

At our facilities we have initially eliminated the need for building an extra loop by inventing a way to transmit data under voltage using a wireless data logging transmitting system. Basically, the conductor temperature was measured by means of a smart link telemetry system which was installed on a length of the same cable as that which was under test. Thermocouples were directly attached onto the surface of the conductor of the control cable and were connected to a wireless transmitter nearby. The control cable was installed between the outdoor terminations as seen in Fig. 1 (in series with the test loop). The conductor in this length of cable carried the same current as the test loop conductor.

In this paper we discuss our upgraded temperature monitoring and control system, which we developed and employed to replace the previously used wireless one. The new system is based on fibre-optic technologies for temperature monitoring under High Voltage. The advantage of such system is the fact that the fibre-optic cables are insulated and could be attached safely (directly) to the energized conductor. We designed a setup that allows us to continuously capture the temperature reading of the cable conductor, which enables us to implement control of the heating current continuously and automatically. The fibre-optic temperature monitoring and control system has been already tested, in monitoring and in control mode, on a 132 and on a 138kV cable system type tests and it performed very well. It is currently being deployed as the primary monitoring and control system on a 240kV cable system type test. The setup is shown in Figure 2.

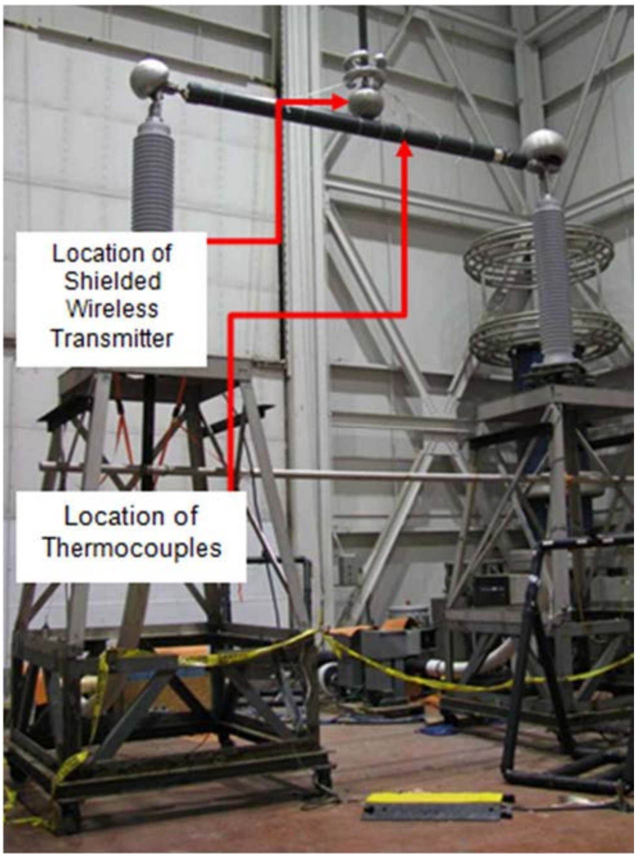

Fig. 1: Cable system test setup showing control cable piece and telemetry system installation point

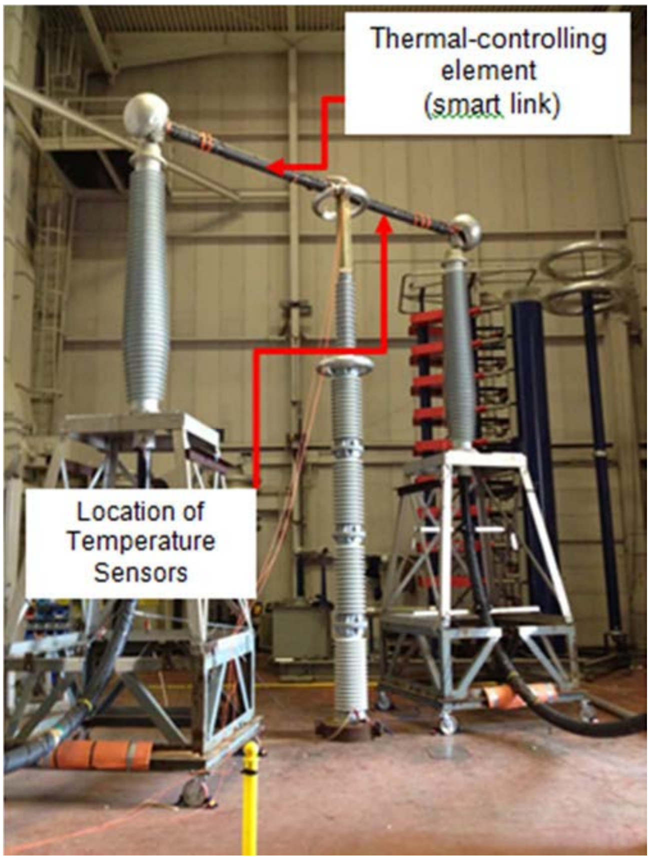

Fig. 2: Cable system test setup showing control cable and fiber-optic temperature monitoring and control system installation