Partial Discharge Testing

Why Use PD Testing?

The strength of the insulation of a high voltage system is an important property. Insulation is typically designed to be able to protect against typically applied voltages for an application with a safety margin for overvoltage phenomenon. If the insulation is not of sufficient strength (poor design) or more likely it degrades as it ages, the separation of high voltage and earth (or other phases) may be inadequate. This loss of separation can lead to faults - from partial discharges and small short circuits to insulation failure leading to shorting high voltage to earth. There is a need for techniques to determine the strength of the insulation allowing the assessment of potential for inadequate separation. One such method used is partial discharge testing.

On-Line Testing

On-line testing does not occur often due to the interference caused by being in the field, but techniques are being developed to minimise these effects. Another problem with on-line testing is the operating temperatures of equipment - it is above room temperature were most testing is done.

The subject of this thesis was to see if temperature affected partial discharges. More specifically, the difference in PD patterns at room and operating temperature of a cross linked polyethylene (XLPE) cable.

CDA3 Computer System

The partial discharge measurements were carried out by a standard discharge detection system (Robinson Instruments Partial Discharge Detector) as a reference, but the main analysis was done using data from a computer based system - the CDA3 system developed at UNSW. This system connects to a Robinson Detector and records the individual PD pulses and displays them in a graphical form and calculates statistical moments.

Method

To simulate an operating cable temperature gradient, the best method would be have a current flowing through the core similar to operating conditions. This was done using five current transformers connected in parallel, placed around the cable. The cable was then formed into a loop and the two ends joined together. A voltage could then be applied to the current transformers which would then induce a current in the cable; the cable operating as the secondary coil to the current transformers acting as the primary. By using this method, the heat is generated in the inner conductor as $I^2R$ losses, and this heat is transferred to the outside as would occur in service.

For the high voltage tests, high voltage was connected to the join between the two ends of the cable allowing the inner conductor to be at the applied voltage. The sheath of the cable was connected to earth.

Conclusion

After analysis of the results, there is support to conclude that there is a temperature effect on partial discharges, seen in increased PD activity and change in the phase position as to where they occur.

This was seen in testing of the 11kV cable and limited testing of one of the 22kV cables. For the other 22kV cable there were large variances in the results and so no clear temperature effect was observed. This was due to different experimental setups.