Partial Discharge Analysis of Defective Three-phase Cable

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Power distribution cable networks represent a dynamic and complex challenge with regard to the issues of maintenance and providing a reliable, high quality supply of electrical power. Utilities historically used regular off-line testing to investigate the health of their assets. This method of testing is reasonably effective for this purpose but does have certain drawbacks associated with it; customer supply can be interrupted during the testing process and the cables are generally not tested under normal operating conditions. Meaning that the test data is not representative of the Partial discharge (PD) activity that is apparent under on-line conditions and the testing activity itself could trigger previously dormant PD sources.

The modern approach for understanding the health of medium voltage (MV) cable distribution networks is to continuously monitor the assets whilst on-line. Analysis if the field data is then used to inform decisions regarding asset replacement and maintenance strategies. PD activity is widely recognised as a symptom linked to the degradation of the dielectric properties of high voltage plant. UK Power Networks sponsored research is being undertaken to investigate the evolution of PD activity within three-phase paper insulated lead covered (PILC) cables containing introduced defects. An experiment has been designed to stress cable lengths in a manner that is representative of the conditions met by on-line circuits [1]. A cable section containing a defect that is known to lead to the premature failure of in-service cables has been PD tested over a range of operating temperatures. The experiment utilizes three-phase energization at rated voltage as well as thermal cycling of the cable to replicate the daily load pattern experienced by circuits in the field. The extension to this work involves PD testing cable samples containing a range of defects to produce a data set consisting of PD pulses produced by varied sources. Analysis of this data should lead to a better understanding of the signals produced by the premature ageing of these types of cable.

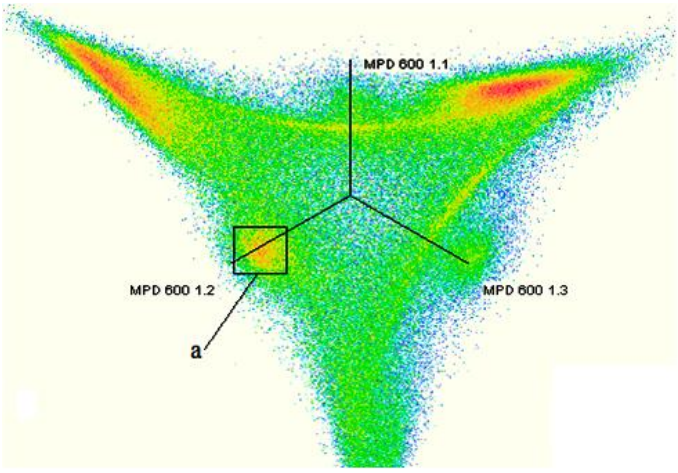

Figure 1: 3PARD plot showing produced by cable sample at 37 ºC.
a: PD activity generated by the defect.

[1] J. A Hunter, L. Hao, D. J. Swaffield, P. L. Lewin, N. Cornish, C. Walton and M. Michel, "Partial discharge in medium voltage three-phase cables", *Conference record of the 2010 IEEE International Symposium on Electrical Insulation*, 2010