Performance of the Partial discharge equipment and the future of online monitoring system in National Grid SA network

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ABSTRACT

In NG cables are mainly XLPE, although NG have few circuits of oil filed cables still working in the network. Due to the repeated insulation breakdown which lead to failures of cables and its accessories, NG[SA] started some partial discharge tests using both the portable partial discharge equipment and online partial discharge monitoring system. This paper would represent the history of PD technology and discuss the latest technology key aspects of working mechanism offered in the international markets. Also, this paper would highlight the most effective solutions for insulation breakdown in the cables network. The paper will recommend a proposal that would help in reducing the errors founded in the existing technology. Finally, the paper will give recommendations for upgrading the performance of power networks, how the building of predictive maintenance system will do a cost reduction on the present asset management practice, and how moving towards the Condition Based Maintenance (CBM) is essential.

KEYWORDS

Partial Discharge, Insulation Breakdown, Partial Discharge Analysis, Condition Based Maintenance.

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INTRODUCTION

Introduced defects like voids/cavities, bad adhesion between insulation and electrodes, contaminants, etc. can all contribute to reduce the lifetime of power equipment. The overall purpose of condition assessment of a power system is to ensure a long life of the grid at a minimum of cost. Partial Discharge (PD) is an electrical discharge that does not completely bridge the space between two conducting electrodes. The discharge may be in a gas filled void in a solid insulating material, in a gas bubble in a liquid insulator or around an electrode in air. When partial discharge occurs in a gas, it is usually known as corona. Many researches already had been done to find PD mechanism, the PD detection techniques, the relationship between PD and the damage they cause to insulating materials and insulating system, the location of PD sources and the problems related to avoid external interference [1]. Techniques for detecting PD depend on what different physical properties which accompany the occurrence of PD, are measured. Known physical properties which have been used in the measurement include electromagnetic emission (in the form of radio wave, light, and heat), acoustic emission (in the audible and ultra-sonic ranges), ozone formation, and the release of nitrous oxide gases [2]. Measurement of an electrical quantity is convenient and can give precise recording of PD variations in the laboratory. However, it can give an inaccurate recording for conditions at on-site e.g. to monitor in-service cables. The inaccuracy is due to the various disturbances and interferences which can be a result of the high environmental noise level [3]. From the experience of PD of on-line and off-line testing of MV and HV cable networks [4], a large percentage of in-service cable faults occur within the first three years of service life. It is also known that these failures typically occur at the cable accessories (cable joints and terminations) and are normally caused as a result of incorrect installation of these accessories (which are 'made-up' on site). In Reliability Centered Maintenance (RCM) parlance, these 'early-life' failures are referred to as the 'Infant Mortality Phase' from the RCM 'Bathtub Curve', as they occur within the initial stages of service life. This is illustrated below in Figure 1. Knowing the stages of service life and how can PD lead to failure in the cable's life service it's obvious the importance of studying partial discharge history, fundamentals, detection techniques, and its future implementation in power networks, which will be discussed in this paper.

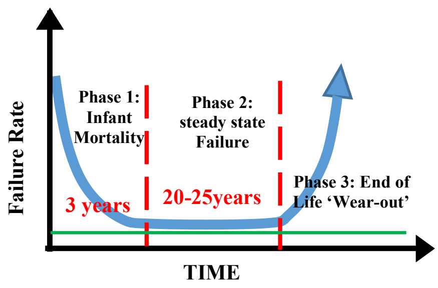

Fig 1 RCM 'Bathtub Curve' showing the 3 Main Phases

PARTIAL DISCHARGE

Partial discharge is generally accepted as the predominate cause of long-term degradation and eventual failure of electrical insulation. As a result, its measurement is standard as a part of the factory testing of most types of high voltage equipment. Test specifications set a maximum permissible level for partial discharges depending on the type of equipment being tested and the insulating material used. The principle behind such a specification is that discharges below a certain size cause minimal damage to the insulation. As insulation systems have increasingly moved towards polymers, acceptable discharge levels have lowered dramatically as they are less resistant to damage by discharge.

HISTORY OF DISCHARGE MONITORING

Partial discharge has been observed as a phenomenon occurring in stressed high voltage insulation since the turn of the century. It became of increasing academic interest from the 1930s when its degrading effect on high voltage insulation became increasingly problematic. Early studies used ultrasonic detection techniques to assess discharge activity in oil. In the 1950's theoretical and practical studies led by John Mason looked at how discharge activity could lead to previously unheard-of breakdown processes like