

## CONDITION ASSESSMENT OF TRANSMISSION POWER CABLES

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### ABSTRACT

*This contribution focuses on the application of condition assessment of service aged transmission power cables (voltage range from 50kV up to 150kV) and the use of advanced condition assessment tools. The experiences discussed in this contribution are obtained in the Netherlands within a Dutch project on knowledge rules generation for condition assessment of oil-impregnated and gas-pressure HV cable circuits. In particular on-site testing and diagnostic results as obtained on a number of cable circuits and evaluated using laboratory investigation on material samples of defected and aged insulation are used to propose practical tools for technical condition assessment and Asset Management knowledge rules generation.*

### KEYWORDS

Transmission power cables, on-site testing, diagnosis, partial discharges, aging, dissipation factor measurement, condition assessment, asset management.

### INTRODUCTION

The, average age of the transmission power networks is 30 years nowadays [1]. According to [2], on average, around 32% of HV power networks in the world are constructed with oil-impregnated paper insulated cables. However, oil-filled OF cables are relatively old, on one hand only around 12% of failures in this type of cables are caused by aging processes, figure 1. On the other hand, it is expected that failures in OF cables will stay at constant, low level or will display linear increase [2].

In order to estimate the actual condition and-or to avoid unpredicted failures in OF, different types of diagnostics and withstand test are performed. In a case on newly installed cable circuits, number of requirements specified by IEC or IEEE standards [1-3, 16] can be found, where the type and level of testing voltage is described. Nevertheless, for service-aged, refurbished or repaired cable circuits the knowledge about on-site diagnosis test is still limited. The international regulations support several maintenance activities and propose different methods to estimate the actual condition of an OF circuit [5-7]. Nowadays for almost all utilities it is essential to develop the knowledge to assess the technical condition of cables and, in particular, to understand the degradation processes, this is becoming at utilities more and more an important asset management issue.

For OF during on-site diagnostics, by measurements of dissipation factor ( $\tan\delta$ ), the information about current insulation condition can be obtained [8]. It must be emphasized that measurements under service conditions



**Fig 1: Service-aged HV (150 kV) gas pressurized power cable.**

e.g. up to 1.0U<sub>0</sub> or higher of dissipation factor  $\tan\delta$  becomes important diagnostics method for oil-impregnated insulation [4,5,9] as it is non-destructive diagnostic method and does not lead to additional stressing of the insulation. Thus, important is how to interpret the measurements results and what are the acceptable levels of parameters obtained during on-site diagnostics.

### POWER CABLE INSULATION

As comparing to distribution power cables, with regard to recognition of insulation defects in transmission power cables less investigation has been done till now. Based on [6-14] where an extended evaluation of most types of typical problems for different types of power cables is given, the applicability of diagnostics e.g. partial discharges and dissipation factor estimation can be evaluated, figure 2. As a result with regard to typical defects that occur in the cable insulation and the resulting insulation deterioration several defect introducing factors are of importance: the operational stresses, the environmental stresses and the human influences. The latter stress is mainly involved at the start of the lifetime of