NEW GENERATION OF ON-SITE TESTING TECHNOLOGY FOR TRANSMISSION POWER CABLES

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ABSTRACT

Modern on-site testing and diagnosis of transmission power cables up to 240kV consists of voltage testing, partial discharge detection and dissipation factor measurements. Applying AC voltages for this purpose has become in last year a common use. In addition to continuous AC energizing more and more the use of damped AC energizing is getting worldwide attention. In this paper, the use of modern technological solutions in power electronics and signal processing as well as in technical design and production methods will be discussed on the basis of damped AC systems up to 350 KV.

KEYWORDS

Transmission power cables, on-site testing, resonant circuit, damped AC voltages, partial discharges, dissipation factor.

INTRODUCTION

For complete on-site testing of transmission power cables up to 380 kV by voltage testing, partial discharge detection and dissipation factor measurements it is necessary to energize the disconnected cable system. Energizing and testing high capacitance components, e.g., long cables, at an AC over-voltage demands a reactive power of several MVA e.g. for testing a 13km long 230kV cable circuit a test current of 180A is needed and for a 25km long a 250A current is requested. To fulfil these demands on power availability on-site is very complex and therefore world-wide the most applicable after-laying approach of transmission power cables is based on 24hrs 1Uo tests [1, 2]. Referring to [3] practical realization of such tests with test voltages higher than nominal voltage Uo becomes more attractive if modern on-site testing methods are characterized by

a. Lightweight and high level of mobility of the test system -> lower transportation, maintenance and logistic cost,
b. Test system compactness versus output voltage, -> accessibility to a large type of sub-stations,
c. Easy system assembling and low erecting effort -> lower costs of test executions,
d. Low necessary power demand for testing long cable lengths → applicability for all types of cable circuits,
e. Possibility of sensitive standardized PD detection and dissipation factor measurement -> comparison to factory testing experiences.

The sinusoidal damped AC voltages have been proposed 20 years ago as a complementary and/or alternative method to sinusoidal continuous AC voltages [4-12]. The DAC method has become accepted in the last years for on-site testing and standardized PD measurements of all types and length of power cables [13-16]. Moreover as compared to conventional continuous AC testing, DAC systems fulfil the above under the a-e mentioned characteristics of modern on-site testing methods (fig. 1).

It is known that a damped AC (DAC) system requires much less power to energize large capacitive loads and has the advantage of reduced up to 20 times volume and weight, as compared to conventional AC resonant systems. This is possible due to the fact that the DAC method uses a charging current and that the capacitive test component resonates with an air core inductor without reactive power compensation.
In this paper, based on general considerations, the

Fig. 1: On-site application of a 350 kV damped AC test system (OWTS HV Technology) on a 28 km long 230kV power cable connected with a test adapter to the GIS enclosed cable termination. The system consists of: (from the left to right) unit 1: High Voltage power supply Unit, unit 2: HV switch with light triggered thyristors (LTT), unit 3: Inductance Unit, unit 4: coupling capacitor, embedded computer system with remote control (Control unit, PD analyzer), Voltage Divider