Water Propulsion Cable Laying and Non-destructive Commissioning of Power Cables

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ABSTRACT

This contribution supports modern distribution power companies in their optimization demands on flexibility, effectiveness in installation and reliable quality assurance of newly installed power cable networks.

This paper presents a combination of two technologies, innovative cable installation by water propulsion as well as non-destructive sensitive after-laying testing using the damped AC technology that have been used for distribution power cable networks.

KEYWORDS

Distribution power cables, innovative installation by water propulsion, non-destructive after-laying testing by PD monitored damped AC after-laying testing.

INTRODUCTION

Continuous grow of the electrical infrastructure and higher demands on the reliability of power cable networks trigger industries for providing modern, cost-optimal and less harmful solutions for both the power cable installation and the quality assurance.

It is known that regarding the installation, the latest technological innovations of using water propulsion, a declination of jetting-techniques as a cable laying process has to be considered.

The main advantages brought by this method are the higher security in the cable installation while needing fewer operators, a reduction of the number of connections and the cost of civil work.

The easiness of handling the equipment due to its compactness, its mobility confers superior safety during the installation while laying the cable with high speed will be discussed.

Fig. 1: Examples of (a) Watucab (WAter TUbe CABle) technology used for the cable installations and (b) Damped AC Voltage (DAC) system applications for commissioning newly installed cable systems.

Regarding the quality assurance after the installation non-destructive, sensitive commissioning of installed cable networks the use of PD monitored voltage withstand testing e.g., using damped AC (DAC) methodology is known. In particular, the commissioning the damped AC technology provides quality assurance of the newly installed cable circuits. By means of partial discharge (detection and localization) and dissipation monitored non-destructive voltage site acceptance tests the quality of the installation has been verified and a „finger print“ has been generated for condition-based maintenance during operation.

In this contribution supported by practical applications a combination of both innovative installation as well as non-destructive sensitive after-laying testing will be presented, see fig. 1.

POWER CABLES INSTALLATION USING WATER PROPULSION

The traditional way to install cables into ducts is pulling them with a winch. For this, first a pulling rope has to be installed. Also, installation equipment and people are required at both ends of the duct. Furthermore, the capstan effect (friction of the cable under tensile load in bends) limits the cable lengths, which can be installed in one pull. Synchronization between winch and drum pay-off is often troublesome.

Three new techniques have been developed to install energy cables into ducts. They are known as Watucab (WAter TUbe CABle) [1-10] and are using the floating-, water-push-pulling- and free-floating techniques.

Floating

With the first technique, called Floating [1-5], water under pressure is injected into the duct together with the cable, creating a high speed (higher than the cable speed) water flow, while at the same time the cable is pushed into the duct (and pulled from the drum). The high-speed water flow creates a distributed drag force propelling the cable. This distributed force locally compensates the friction between cable and duct, avoiding axial force build up in the cable, hence eliminating the capstan effect. The same trick as with cable blowing, a technique used worldwide today to install optical cables into ducts.

The additional beneficial effect with floating is the buoyancy of the water, reducing the friction between cable and duct. With this technique extremely long installation lengths can be reached (with Low Voltage cables already 10 km has been reached, and with optical cables up to 12.4 km), also in trajectories with many (preferably smooth) bends.

Moreover, there is the benefit of single point entry (installation equipment, cable drums and people), see fig. 2, reducing operation and labour costs considerably. The technique is user and cable friendly (low forces, no cable wear) with compact equipment and does not suffer from synchronization problems with the cable drum. With the present equipment a comfortable cable speed of 15 m/min can be reached.

Water-Push-Pulling

The second technique, called Water-Push-Pulling [1-9], is mainly the same as the floating technique, except that a pig is mounted at the head of the cable, see fig. 2. Now all forces exerted by the water under pressure are