AC RESISTANCE OF SUBMARINE CABLES.

Paolo **MAIOLI** (1), Massimo **BECHIS** (1); Gaia **DELL'ANNA** (2)
1 – Prysmian S.p.A, Milan, Italy, paolo.maioli@prysmiangroup.com, massimo.bechis@prysmiangroup.com
2 – Prysmian Power Link S.r.l, Milan, Italy, gaia.dellanna@prysmiangroup.com

ABSTRACT

The development of HV large section three core power cables is a great challenge from the point of view of the correct determination of losses dissipated into the armoring. The paper illustrates measurements, calculations and modelling of armor losses in order to design a state-of-the-art cable, with optimised use of materials.

It is known that submarine cable resistance increases with current, so that it is important to make the measurement at the rated current and frequency. Experimental evidence shows that the losses are affected by the way how the cable is designed. A test bench has been developed in order to provide accurate measurement of the electrical characteristics of these large cables.

KEYWORDS

AC resistance - Power losses – HV cable – Submarine cables – Measurement apparatus – Current injection – Cable modelling – FEM method.

INTRODUCTION

The recent development of large off-shore power generation is driving the installation of High Voltage submarine cables which are typically used to connect the off-shore hub to the mainland power network.

These connections represent a first example of submarine electrical grid that is likely to further expand and develop to form a future off-shore submarine super grid.

A series of parameters and environmental conditions are considered in order to decide the cable design to be used; in particular the design of such large cables necessitates a precise knowledge of the losses, in order to provide accurate values of the thermo-electrical characteristics.

Theoretical studies and experimental analysis helped to optimize the designs in order to comply with specific requirements. This paper deals with the analysis and studies related to the cable losses in the metallic armor.

MEASUREMENTS

Many test and measurement have been performed in laboratory to verify the electrical characteristics of these cables.

Sample preparation

The cables are generally in samples 12 meters long, and arranged in the laboratory in straight configuration placed on plastic support, to avoid interference and additional losses induced by extraneous metallic parts.

Figure 1 shows the section of a HV three core power cable, with lead sheath, shaped fillers with optical fibre cables and armoring wires.

Fig.1: HV cable section before measuring, with lead sheath and optical fibre cables

Extremities of the sample are prepared with care in order to have a compact assembling that reduces end effect and uncertainties on sample length (Fig.2).

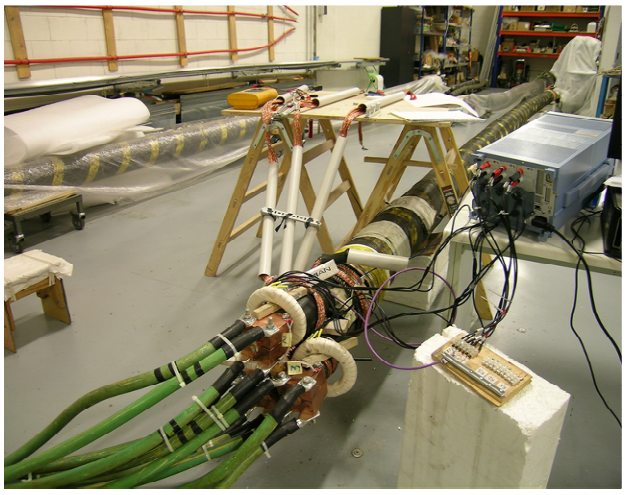

Fig. 2: General view of the current injection apparatus and measuring devices

Copper clamps, with a modified designed, are connected above and below the conductors of the power cable, for a better injection of the current, very important for large section conductors.

Low resistivity connection cables are used, green cables in Fig.2, for high rate measures and reduced temperature variation, to improve current stability.

Current injection from the power supply has been verified for current and voltage harmonics: harmonic power