CABLES FOR DEEP WATER APPLICATIONS

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ABSTRACT

Increased need for bulk transmission networks includes the necessity to interconnect Countries with a larger number of challenges.

One of them is relevant to submarine cables and it is the need to cross deeper waters with large high voltage and high power cables. This paper describes design, testing, manufacturing and installation experiences and gives a broad view of issues to be considered for these cables.

KEYWORDS

Deep waters, Submarine cables, Design criteria.

CHALLENGING INTERCONNECTIONS

Networks of the future will likely be formed by a mix of small distribution networks, inclusive of energy generation and storage, and large networks for bulk transmission capable to interconnect various countries and energy markets.

The perspective increased need for high power interconnections is also driven by the tendency to produce electrical energy remotely from where it is largely consumed: current examples include large offshore wind parks, but potential developments embrace for example solar energy produced in the Saharan regions of Africa to be transported and consumed in Europe.

This implies increasing the need for submarine cables. In particular there are a number of upcoming developments that would likely need very long and very performing power cables to be installed and operated at very high depths.

DESIGN CRITERIA

The particular aspects which need addressing for deep water applications are:

- Pulling forces, due to the long suspended weights of cable during installation and recovery

- Bending under tension, on the installation vessel sheave, capstan etc.

- External water pressure

The main design criteria include a range of key parameters to be studied and verified to enable the cable to withstand safely the high levels of mechanical forces acting on the cable in deep water installation and service

Elongation

Essential parameter to be considered is the cable elongation, that has to be kept within acceptable limits from a structural and material performance (e.g. insulation) viewpoint.

Maximum allowable elongation is a function of cable design, that should ensure that most of the pulling force is taken by the armouring structure. Materials used for the armour must have elongation yield points higher than the stresses experienced during installation and testing.

Rotation

Additionally, cables should be designed to minimize rotation (i.e. unbalanced torque generation) under tensile loading.

This can lead to uncontrolled mechanical stress and/or concentrated deformation inside the cable structure.

High levels of torque can also lead to the danger of throwing cable loops if there is loss of tension control during the installation of the cable. To this end a double, contradirectional armour is generally required.

Fig. 1: Example of armour design for deep waters (Italy-Greece)