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# Energy transmission on long three core/three foil XLPE power cables

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**Abstract:** The limit in length for AC power transmission over three core XLPE submarine cables and single core XLPE land cables laid in three foil formation are investigated.
There are an increasing number of projects where power transmission from offshore power generation or power supply to offshore consumers is considered. Most of these transmission links have lengths between 20 and 150 km.
Acquiring right of ways for overhead lines on land is costly, time consuming or nearly impossible in densely populated areas. One alternative energy transmission mode is by AC single core cables laid in three-foil formation. The investigation shows that by using reactive compensation in both ends, 3-core submarine cables can be used for links up to around 250 km. Underground cables laid in three-foil formation can be used for even longer lengths if intermediate compensation is installed.

**Keywords:** HVAC- High Voltage Alternating Current,
XLPE- Cross-linked polyethylene, Three-core submarine cables,
Three-foil land cables,
Charging current, Compensation.

**Résumé:** Les limites de longueur de pose des câbles tripolaires sous marins isolés XLPE et câbles monopolaires souterrains posés en trèfle sont étudiés.
Il y a une augmentation du nombre de projets pour transporter de la puissance à partir d'installations offshores ou pour alimenter des systèmes offshores. La plupart de ces liaisons ont leur longueur comprise entre 20 et 150 km.
L'acquisition des droits de passage pour les lignes aériennes est de plus en plus coûteux, demande du temps et est presque impossible dans les zones de forte densité de population. Dans ce cas, une alternative pour le transport de l'énergie est la pose de liaisons souterraines. Les études montrent qu'en utilisant des réactances aux deux extrémités, les câbles sous marins tripolaires peuvent être utilisés pour des liaisons de longueur jusqu'à 250 km environ. Les liaisons par câbles souterrains posés en trèfle peuvent atteindre des longueurs encore plus importantes si des systèmes de compensations intermédiaires sont utilisés.

## 1 General

It is well known that the relatively high capacitance of power cables compared to overhead lines limits the transmission length with HVAC cables. However, it is not generally known where this limit is for modern HVAC cable systems, based on XLPE insulation. The purpose of this investigation is to define and find the limits for submarine and underground HVAC cable systems. Comparison of the power losses with alternative HVDC transmission systems will also be attempted. Typical applications where HVAC and HVDC systems are compared are power transmission from offshore windmill parks or power transmission from shore to offshore oil fields.
There are a number of criteria used when a transmission system is designed, electrical, environmental and so on, but as long as both HVAC and HVDC systems are technically feasible, the cost of the transmission system is usually the deciding factor.

### 1.1 HVDC transmission

HVDC transmission from offshore windmill parks or to offshore oil fields is made possible by the use of Voltage Source Converter, (VSC), technology. Although this technology can start up with no rotating