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GROUP REF. : B1
PREF. SUBJECT : 1
QUESTION N° : 3

High depth MI cables future applications

XLPE cables have a simpler design, manufacturing process and a higher power rating. Combined with VSC converters, it makes them the preferred DC cable technology for offshore windfarms and for some interconnectors.

There are cases where XLPE technology is the only solution to transmit the required power, such as the case of future 2 GW offshore windfarms connections. We must consider that the typical installation configuration for these projects is with two or more cables in bundle. It is an optimal solution from installation time and economic perspective; also, installation corridor is smaller and so permits are easier to be obtained. However, it is the worst condition from a thermal rating point of view, which as a matter of fact excludes MI cable from the picture. This can be seen in Figure 1.

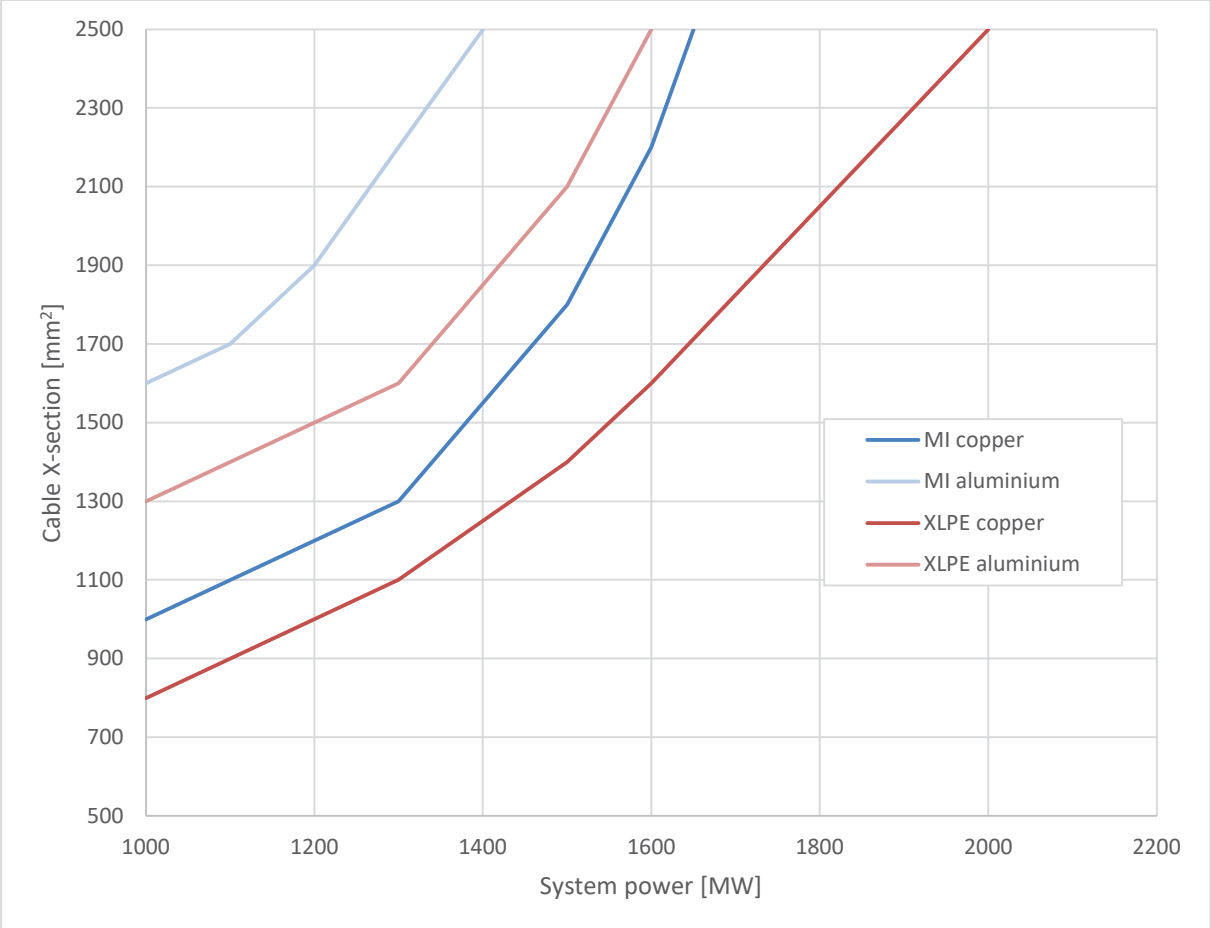


Figure 1 Different power ratings for different submarine cable technologies, considering typical bundled installation in a sea environment.

When power ratings are lower, such as in the case of a 1.4 GW connection, XLPE cable can deliver the power using smaller conductor cross section or even switching from copper to aluminum conductors, leading to considerable economical savings.

However, there are applications where the cable conductor cross section isn't only thermally driven, but also mechanically driven: this is the case of high depth submarine installations.

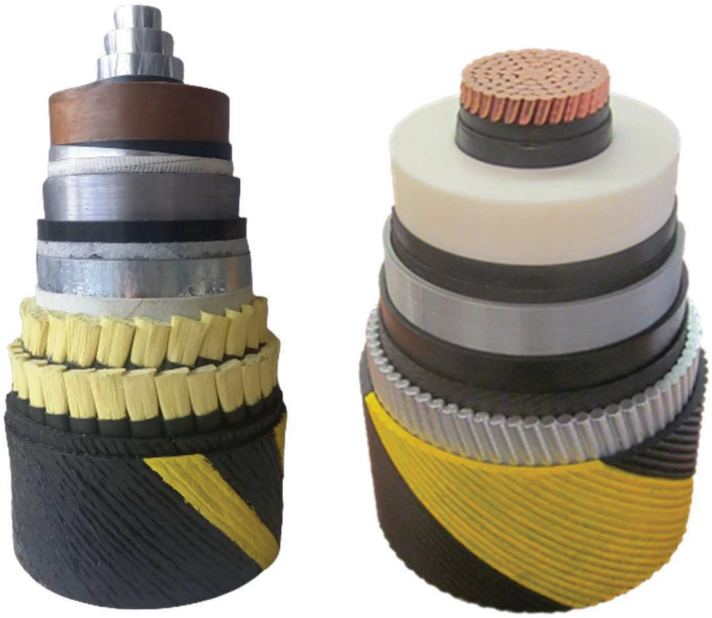


Figure 2 High depth cables with innovative armour solution.
Left: MI cable. Right: XLPE cable.

In such cases, the metallic layers composing the cable shall withstand the mechanical efforts produced by the extremely high installation tensions. Even though the average density of an MI cable is higher than XLPE, they have a thinner insulation package, giving in the end the same weight of an XLPE cable, hence the almost the same installation loads.

This means the conductor and armour shall withstand the same forces for both designs and it won't be possible to reduce the XLPE cross section exploiting its higher operating temperature. The economic advantage of XLPE compared to MI is reduced/equalized.

It shall be also highlighted that these installations are typically with a single cable and not in bundle, providing a relief to the thermal constraints of MI cables.

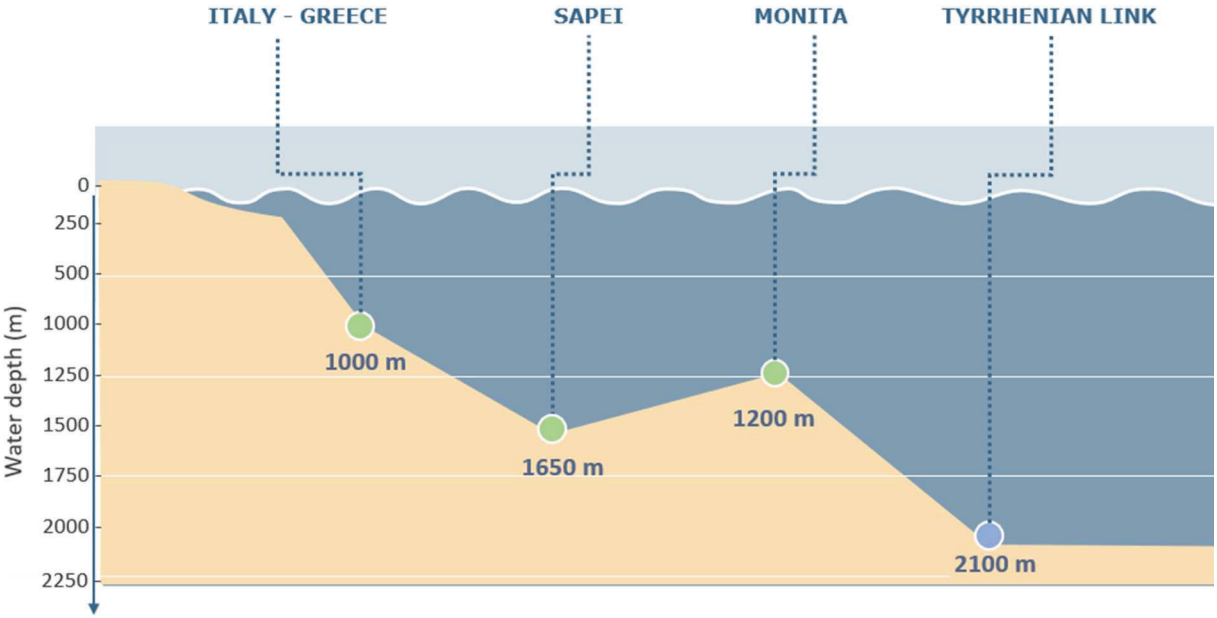
We can consider a case study of a 1000MW link. The minimum cross section needed for an MI cable is 1600mm^2 aluminum conductor, while for XLPE is a 1200mm^2 aluminum conductor thanks to its higher operating temperature. Considering a classic high depth design with two layers of steel flat wire armour, the cable difference between MI and XLPE is just 5%. On the contrary, thanks to the larger area of metals and higher axial stiffness of the MI solution, the maximum mechanical load applicable to the cables is 30% lower for XLPE cables.

Cable technology	Power rating	Cross section	Weight	Max. mechanical load
MI	1000 MW	1600Al	100%	100%
XLPE	1000 MW	1200Al	95%	70%

Table 1 Comparison of XLPE and MI cable designs, with cross section defined by thermal rating only

MI cables were installed and have been operational for more than 10 years at the highest record water depths of 1650m (SAPEI). Other references include installations at 1000m (Italy-Greece)

and 1200m (MONITA). In the coming years, they will also be installed at 2100m (Tyrrhenian Link).



MI cables are therefore a proven and reliable solution for high depth projects, whereas XLPE cables still have to build up the operational experience at these depths.