Submarine cable systems
Who we are

Tracing its industrial roots back to 1950, Cablel® Hellenic Cables has evolved into a leading European provider of reliable and competitive cable solutions. With 6 manufacturing plants across 3 countries, Cablel® Hellenic Cables covers a wide range of cable products and solutions, from Land and Submarine Power cables to Fiber Optics, Telecommunication cables and Magnet Wires.

Cablel® Hellenic Cables offers a wide range of integrated solutions, including design, manufacturing, planning, project management and installation. In-house R&D and testing facilities guarantee continuous product development and innovation.

As the world’s need for sustainable and reliable flow of energy and information continues to increase, we remain focused on our mission to provide top-quality products and services meeting the highest technical and environmental standards set by our customers.

In Fulgor, investments of over EUR 150 million since 2011 were made for the production of high and extra-high voltage submarine and underground cables.
Submarine Projects

<table>
<thead>
<tr>
<th>Project name</th>
<th>Year</th>
<th>Customer</th>
<th>Country</th>
<th>Length</th>
<th>Cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclades Interconnection</td>
<td>2014-16</td>
<td>ADMIE Holding</td>
<td>Greece</td>
<td>114 km</td>
<td>150 kV 3x630 mm² 3x300 mm²</td>
</tr>
<tr>
<td>Hollandse Kust Zuid</td>
<td>2018-2022</td>
<td>TENNET BV</td>
<td>Netherlands</td>
<td>158 km</td>
<td>220 kV 3x1400 mm² 220 kV 3x1000 mm² 66 kV 3x500 mm²</td>
</tr>
<tr>
<td>Cyclades B Interconnection</td>
<td>2018-2020</td>
<td>ADMIE Holding</td>
<td>Greece</td>
<td>53 km</td>
<td>150 kV 3x300 mm²</td>
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<tr>
<td>Crete Interconnection</td>
<td>2018-2020</td>
<td>ADMIE Holding</td>
<td>Greece</td>
<td>135 km</td>
<td>150 kV 3x630 mm²</td>
</tr>
<tr>
<td>MOG</td>
<td>2018-2019</td>
<td>ELIA</td>
<td>Belgium</td>
<td></td>
<td>220 kV 3x1800 mm²</td>
</tr>
<tr>
<td>St. George Wind Farm</td>
<td>2015</td>
<td>Terna Energy</td>
<td>Greece</td>
<td>37 km</td>
<td>150 kV 3x300 mm²</td>
</tr>
<tr>
<td>Kafireas Windfarm</td>
<td>2017-2019</td>
<td>ENEL</td>
<td>Greece</td>
<td>47 km</td>
<td>150 kV 3x800 mm²</td>
</tr>
</tbody>
</table>

Interconnection

6 manufacturing plants in 3 countries

Sales in more than 50 countries

Established 1950

State of the art facilities

MV < 33 kV  HV < 275 kV  EHV > 275 kV

Interconnection  OWF (Offshore Windfarm)
Subsea interconnectors

High Voltage AC submarine cables are 3-core or single core armoured, with Copper or Aluminum conductors, XLPE insulation and Lead sheath over each insulated core as a radial metallic water barrier. Available voltage ratings range from 150 kV to 400 kV.

Standard HV submarine cable designs typically include one or more optical units. Optical units are assembled during manufacturing between the outer interstices created by the insulated conductors.

Export cables for offshore wind farms

Increasing size of individual turbines as well as overall wind farm sizes, naturally leads to continuously increasing requirements for power transmission capacities of export cables. This in turn translates to increasing voltage levels, from 150 kV, to 220 kV or even 275 kV.

Market leading capabilities for risk mitigation

Cablel® has a unique advantage in the segment, due to its recent investments in high capacity, state-of-the-art production and storage equipment. All HVAC designs can be manufactured in very long continuous lengths, minimizing the need of factory joints and thus the risk of failures.

Factory joints are flexible splices performed on each core under the continuous protective layers of the cable and constitute an integral part of the cable. Minimizing the number of factory joints greatly reduces the risk of cable faults.

Optical fiber submarine cables for repeaterless links

We offer Light Weight (LW), Single Armoured (SA) and Double Armoured (DA) designs that include an optical core made of a sealed stainless steel tube containing up to 48 single-mode optical fibers. The optical fibers are placed loosely inside the tube with excess length and surrounded by a filling compound (jelly) containing a hydrogen scavenger. Over the optical core, successive protective layers are applied. For maintenance purposes, the cables are qualified to the Universal Quick Joint (UQJ).
Medium voltage cables

We manufacture 3-core armored MV cables up to 66 kV, with copper or aluminum conductors and cross-sections up to 1,200 mm². For the shielding, copper wires are used, or coating with layers of copper, aluminum or lead.

66 kV Inter-array cables

The continuous increase of offshore wind farm sizes and wind turbine capacities, has given rise to a clear trend towards higher voltage array cabling, specifically 66 kV. Operating at 66 kV instead of 33 kV provides significant cost advantages:

1. It doubles the power that can be transported over one cable, thus reducing the total length of cable required.
2. Fewer overall cables are required, thus reducing the amount of accessories and equipment required.

AC transmission is used on short distances, typically up to 120 km. As distances increase however, significant decrease in performance is unavoidable, due to the increase of absorbed reactive power. Thus for longer distances, DC transmission is used instead. Supported by the evolution of power electronics and typologies of AC-DC converters.

We offer HVDC cables up to 320 kV with XLPE insulation. The use of an extruded insulation offers several mechanical and electrical advantages, such as lighter, easier-to-handle cables, which can operate at high temperatures and at high electrical stresses.

Working with world-class accessories manufacturers, we are currently developing our own HVDC accessory designs and manufacturing capabilities.

HVDC XLPE cables

66 kV AC Composite submarine cable design

1. Conductor: Al or Cu round stranded
2. Semiconducting tape
3. Conductor non-metallic extruded screen compound
4. Insulation: XLPE water-tree retardant
5. Core non-metallic extruded screen
6. Semiconducting waterblocking tape(s)
7. Metallic screen: Copper wires
8. Semiconducting waterblocking tape(s)
9. Radial watertightness: AL/PE laminated tape
10. Sheath: HDPE and extruded semiconducting compound
11. Extruded profile fillers
12. Binding tape(s) with overlap
13. Polypropylene yarns, one layerstripe
14. Armouring: helically applied bitumen compound coated galvanized round steel wires
15. Polypropylene yarns, two layers
16. Armoured optical unit: stainless steel tube, PE inner sheath, galvanized steel wire armour and PE oversheath
**Dynamic cables**

As near-shore, shallow water areas become saturated, especially in mature markets, off-shore wind development will move further offshore or in deeper waters. Far-shore sites pose additional challenges for installation, O&M, and higher foundation costs moving into deeper water. Floating offshore wind would circumvent a number of these challenges, unlocking deep-water sites. This requires a new generation of cables, called "dynamic", specifically designed to withstand the additional stresses. Cablel® develops intensively its offer of Dynamic Cables, both through extensive in-house R&D and participation in Development Programs.

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**Horizon 2020 - Flotant project**

The main objective of Flotant project is the conceptual and basic engineering to provide, at low cost, increased flexibility and robustness to a hybrid floating structure implemented for Deep Water Wind Farms (DWWF). Main objective is to develop innovative dynamic power cable solutions and corresponding connectors providing an optimized power export system for deep water (100-600 m) Floating Offshore Wind farms.

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**Carbon Trust - Floating wind joint industry project**

The Carbon Trust is an independent, expert partner of leading organisations around the world, helping them contribute to and benefit from a more sustainable future through carbon reduction, resource efficiency strategies and commercialising low carbon technologies. The objective of the Dynamic Export Cable Development is to accelerate and support the development of dynamic export cables for use in offshore wind farms in time for commercial-scale floating wind farm development around the world.

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**University of Exeter**

Fulgor has sponsored a post-doctoral study to develop in collaboration with the University of Exeter numerical hydrodynamic and fatigue service life modelling of dynamic submarine cables including fatigue testing for validation.

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**Services | Turnkey solutions**

In addition to their innovative and specialised products, Cablel® cable companies provide a complete range of services and solutions, tailored to each customer’s requirements:

One of the most important services provided to customers by Cablel® cable companies are the integrated turnkey solutions, concerning high-end projects. The Cablel® cable companies offer a wide range of integrated solutions - from design, to customer staff training and site testing - to specific projects, which are constantly supervised by experienced personnel.

**Our capabilities in submarine cable projects include:**

1. **Cable route survey**
2. **Design & Engineering** of the system
3. **Manufacturing** of submarine and land cables
4. **Transportation** of cables on site
5. **Installation & Protection** of the cables
6. **Supply of accessories**, including repair, transition joints and cable terminations
7. **Project Management**
8. **Commissioning** of installed system
9. **Training & Technical Support**
In-house testing facilities

Fulgor’s new lab features state-of-the-art equipment to carry out development tests, type tests and qualification tests for AC cable systems up to 500 kV and DC cable systems up to +/- 600 kV. In addition, an upgrade of the existing facilities was carried out to conduct electric series tests on long submarine cable lengths.

The new facility, completed in September 2018, can apply maximum voltage of 450 kV and will be used to carry-out tests on cable lengths up to 60 km cables with a rated operating voltage of 220 kV.

Quality

Cablel® cable companies apply strict quality standards and certified management systems that ensure high quality of their products and services, while setting the framework for continuous improvement. All products bear compliance markings and quality labels by internationally recognised certification houses, confirming the continuous controls carried out during the production process and the high standards on which they are produced.

All Cablel® production facilities are certified according to ISO 9001:2015.

Sustainability

Cablel® cable companies have incorporated Sustainability principles into their business operations, as they are a key tool for their long-term growth. The concern of employee health and safety in every activity, the environmental protection, the comprehensive coverage of customer needs, and the support for the local communities in which they operate are the main sustainability issues of Cablel® cable companies and are reflected in their Sustainability Policy.

All Cablel® production facilities are also certified according to ISO 14001:2015, OHSAS 18001:2007 and ISO 50001:2011. Demanding and unexpected conditions could affect productivity, profitability and stakeholder confidence. For this reason, a Business Continuity Plan is developed, certified according to ISO 22301:2012.

Production facility: Fulgor

Cablel® Hellenic Cables operates one of the largest and most advanced submarine cable plants in the world, Fulgor.

Located near Athens, Greece, Fulgor is undergoing an investment program in excess of EUR 150 million over the last eight years to become a trusted provider of turnkey submarine cable solutions for the Offshore Wind industry and Submarine Interconnections globally.
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