LS Cable’s Submarine & Umbilical Cable system
LS cable has been operating seaside plant for submarine cables in Donghae city in eastern coast of Korea

- **Area**: 220,000 m²
- **No. of employee**: 180
- **Submarine Cable**
  - MIND cable (~DC 500kV)
  - EPR cable (~35kV)
  - XLPE cable (~230kV)
- **Industrial & Specialty Cable**
  - Marine / Off-shore
  - Military / Nuclear power

**Main Product**

**Area**

**Donghae plant**
## Manufacturing Capability

**Conductor types**: Keystone

**Metallic sheath**: Extruded Lead alloy (E, 1/2C, Cu-Te)

**Max. delivery length (with flexible factory joint)**: above 100 km

### Production Capability

- **Stranding machine**
- **Paper Cutting & wrapping machines**
- **Oil Impregnation Tank**
Manufacturing Capability

Production Capability

- Insulation: XLPE, EPR
- Metallic sheath: Extruded Lead alloy (E, 1/2C, Cu-Te)
- Jacket: PE, PVC, HFPO
- Max. delivery length (with flexible factory joint): above 100 km
Manufacturing Capability

Laying-up & Armoring

Vertical Laying-up machine

Steel wire armoring

PP yarn bedding

Outer serving
Designated Cable Pier with the Cable Highway makes the Transportation Safe and Reliable

Turn table for storage of complete cable

Gangway

Donghae Port
Multi-core AC XLPE Submarine Cable

**Products Overview**

**AC 22.9kV 3 Core Submarine cable**
(Copper 60㎟/XLPE/Lead/PE + FO 24cores)
- Outer dia.: 120mm
- Weight: 30kg/m

**AC 154kV 3 core Submarine cable**
(Copper 500㎟/XLPE/Lead/PE + FO 48cores)
- Outer dia.: 203mm
- Weight: 82kg/m
**Products Overview**

**DC Submarine Cable**

**DC 250kV XLPE cable**
(Copper 630㎟/XLPE/Lead/Wire Armor)
- Outer dia. : 103mm
- Weight : 26kg/m

**DC 250kV MIND cable**
(Copper 900㎟/Oil impregnated Paper/Lead/Wire Armor)
- Outer dia. : 103mm
- Weight : 32kg/m
**Products Overview**

**ROV Umbilical Cable**

- **Construction**
  - Power Cable: 6C 4AWG 6cores (AC 3300V)
  - Control Cable: 3C 14AWG (AC 240V)
  - Earth Cores: 2C 14AWG
  - Optical Cable: Single mode 2cores
  - Sheath: PE
  - Armor: Double Steel Wires

- Hydraulic Test
- Tensile Test
Products Overview

- Repair Joint
- Transition Joint
- Terminations (on/offshore)

Complete range of accessories for offshore applications
- Armoring clamp, Hang-off and J-tube Seals/Centralizer
2nd HVDC Link line
- Voltage: DC ±250kV
- Transmission Capacity: 400MW
- Route Length: 122km
- Cable
  - Power: 4 Lines
  - Fiber Optic: 2 Lines
- Contract data: Feb. 2009
- Completion date: 2011

1st HVDC Link line
- Voltage: DC ±180kV
- Transmission Capacity: 300MW
- Route Length: 105km
- Cable
  - Power: 2 Lines
  - Fiber Optic: 2 Lines
- Completion date: 1998
The **2nd HVDC project** consists of 2 lines in order to supply electric power to Jeju island. 

**Jindo-Jeju Island HVDC Interconnection PJT**

**Route**
- **1st Line**
  - **Jeju island**
  - **Main land**
- **2nd Line**
  - **Length**: 75.8 mile (122 km)
  - **Water Depth**: max. 25 feet (160 m)

**Installation Cable Formation**

- **Pole #1**
  - Optical Fiber Cable
    - Single mode 48 cores
  - Pole cable
    - DC 250kV MI
  - Return cable
    - 20kV XLPE

- **Pole #2**
  - Optical Fiber Cable
    - Single mode 48 cores
  - Pole cable
    - DC 250kV MI
  - Return cable
    - DC 250kV MI
**Ongoing Project**

**Route**
- Length: 6.8km
- Depth: max. 39m

**Protection**
- Seabed Condition
- Bedrock area
- Sedimentary area
- Bedrock area
- Rock berm (1.5m height)
- Burial (2.5m depth)
- Rock berm (1.5m height)

**Cable construction**
- Cu, 500㎟
- XLPE
- Lead alloy sheath
- Semi-conducting HDPE
- Bedding (PP yarn)
- Steel wire armor
- Outer serving (PP yarn)
- Optical fiber cable (SM 24fibers)

**Project descriptions**

<table>
<thead>
<tr>
<th>Customer</th>
<th>KEPCO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>200MW (100MW × 2 circuits)</td>
</tr>
<tr>
<td>Voltage</td>
<td>AC 154kV</td>
</tr>
<tr>
<td>Route length</td>
<td>Total 6.8km (Submarine 6.6km, Land 0.2 km)</td>
</tr>
<tr>
<td>Water depth</td>
<td>Max. 39m</td>
</tr>
<tr>
<td>Completion date</td>
<td>Oct. 2010</td>
</tr>
</tbody>
</table>
The 1ST Offshore Wind Turbine PJT in KOREA

Route

- Je-ju Island
- Route length: Total 2km (1.5km + 0.5km)
- Water depth: Max. 21m
- Completion date: Dec. 2010

Cable construction

- Cu, 60㎟
- XLPE
- Lead alloy sheath
- HDPE
- Bedding (PP yarn)
- Steel wire armor
- Outer serving (PP yarn)
- Optical fiber cable (SM 24fibers)

Project descriptions

<table>
<thead>
<tr>
<th>Customer</th>
<th>KEPCO</th>
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</thead>
<tbody>
<tr>
<td>Rated Voltage</td>
<td>AC 22.9kV</td>
</tr>
<tr>
<td>Route length</td>
<td>Total 2km (1.5km + 0.5km)</td>
</tr>
<tr>
<td>Water depth</td>
<td>Max. 21m</td>
</tr>
<tr>
<td>Completion date</td>
<td>Dec. 2010</td>
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</tbody>
</table>
TYPICAL DYNAMIC ELECTRO-HYDRAULIC UMBILICAL:

9 x 3/8" (5,000 psi) THERMOPLASTIC HOSES +
3 x 1/2" (5,000 psi) HCR THERMOPLASTIC HOSES +
L.V. ELECTRICAL CABLE (for 2,000m sea depth)
Biz. Model Innovation

- Green Business
  - Eco-material development
  - Value creation by Eco-friendly design
  - Next generation Green technology development
- Application/Solution
  - Target Industry total package development
  - Solution capability
  - New business solution

Globalized R&D

- Global R&D site
  - China/Asian
    - Localized Product development
  - Europe/North America: technology sourcing
  - LSC Head quarter: Core technology
- Global Collaboration & synergy creation

Technology Platform build-up

- Fundamental research on cable
  - creative research on material/design/process
  - focus on customer value creation
- Next generation technology of energy/information transmission
  - Monitoring of technology trend
  - Participation on Industry standard community
  - Scenario based technology risk management

Efficiency & Effectiveness

- Open R&D
  - Collaboration between Research institute, University and industry partners
  - Global Collaboration network expansion
- ROI base Project screening & Monitoring by Stage-gate Process
### R&D Capability

#### R&D Area

<table>
<thead>
<tr>
<th>Power Transmission cable and system</th>
<th>High Performance Power Transmission</th>
<th>LV / MV Cable</th>
<th>Overhead &amp; Busduct</th>
<th>Special Cable</th>
<th>System Solution</th>
<th>Decentralized Power generation system</th>
<th>Industrial Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) HVDC: High Voltage Direct Current, 2) FTTH : Fiber To The Home, 3) GPON : Gigabit Passive Optical Network, 4) HEV : Hybrid Electric Vehicle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **High Performance Power Transmission**
  - 500kV XLPE system
  - HVDC\(^1\) submarine cable
  - High Temperature Superconducting system
- **LV / MV Cable**
  - Vapor-curing 22.9kV
  - Lead free sheath cable
  - Optical fiber composite distribution cable
- **Overhead & Busduct**
  - Low sag & high conductivity
  - Railway & Rolling stock solution
  - Cu/AL compact type busduct
- **Special Cable**
  - Off-shore and Marine cable
  - Subsea Umbilical Cable
  - Cable for Nuclear power plant
- **System Solution**
  - Power line CMS
  - IT+ Management Solution
- **Decentralized Power generation system**
  - Monitoring & Operating system for wind farm
  - Eco-friendly and optical composite cable for wind and solar farm

#### Telecomm.

<table>
<thead>
<tr>
<th>Optical Cable Solution</th>
<th>LAN Cable Solution</th>
<th>RF Cable Solution</th>
<th>Specialty Solution</th>
<th>Electronic Wire &amp; Cables</th>
<th>Future Automobile Components</th>
<th>Magnet wire</th>
</tr>
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</tr>
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</table>

- **Optical Cable Solution**
  - Optical fiber
    - Low loss NZDSF
    - Wideband MMF for WDM
  - Optical cable
    - μABC, ADSS for Metro net.
    - Drop cable for Premise net.
    - Specialty Cables
- **LAN Cable Solution**
  - 10G UTP, FTP, STP cable
  - Connectivity
- **RF Cable Solution**
  - Feeder and Accessory
    - Cu/AL and corrugated or smooth type
  - Active and passive component
- **Specialty Solution**
  - SOC field Solution
    - Intelligent Traffic-control system
    - In Building, Data Center solution
  - Micro Coaxial
    - FA/LAN cable
  - PP for Automobile
  - Tube & terminal
- **Electronic Wire & Cables**
  - Aluminum wire & harness
  - Wire harness for HEV\(^4\)
  - EV Charging system
- **Future Automobile Components**
  - Flat wire for Automobile
  - High performance wire for residential & commercial

#### Automobile & Electronic

- **Rubber, Copper, aluminum**
  - Environmental Friendly Flooring solution
  - High-end wire rod
  - Automotive part

#### Industrial Material

- **Rubber, Copper, aluminum**
  - Environmental Friendly Flooring solution
  - High-end wire rod
  - Automotive part

#### LS Cable

1) HVDC: High Voltage Direct Current, 2) FTTH : Fiber To The Home, 3) GPON : Gigabit Passive Optical Network, 4) HEV : Hybrid Electric Vehicle
R&D Capability

R&D Human Resources (person)

<table>
<thead>
<tr>
<th>Year</th>
<th>R&amp;D Center</th>
<th>Business Division</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>230</td>
</tr>
<tr>
<td>2007</td>
<td>59%</td>
<td>41%</td>
</tr>
<tr>
<td>2008</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>2009</td>
<td>58%</td>
<td>42%</td>
</tr>
</tbody>
</table>

% R&D person / total employee

- 2007: 10.1%
- 2008: 11.3%
- 2009: 15.0%

R&D Center

Degree

- B.S: 68%
- M.S: 23%
- Ph.D.: 9%

Major

- Chemical: 34%
- Mechanical Engineering: 34%
- Electric & Electronic: 19%
- Metal/Materials: 13%
- etc.: 11%
R&D Capability

**CAE Group**

**Fluid & Thermal Analysis**
- Flow & Heat transfer Analysis
- Process Optimization
- Temperature-Limit Design

**Structural Analysis**
- Cable Design & Optimization
- Analysis of Static & Dynamic Behavior

**Metal Forming Analysis**
- Extrusion Forming & Die Design
- Workability Evaluation

**CAE Technology in LS Cable**
- Cable & Product Design
- Manufacturing Process Design
- Construction & Installation Analysis
- Optimization
- Reliability & Life Evaluation

**Electromagnetic Analysis**
- RF & Electromagnetic Field Analysis
- Screen Optimization & Crosstalk Cancellation

**Noise & Vibration Analysis**
- Natural Frequency & Resonance Analysis
- Noise Reduction & Seismic Isolation Design
### Analytical Group

#### R&D Capability

<table>
<thead>
<tr>
<th>Organic Analysis</th>
<th>Cable insulation material, cable compound, organic additives, copper foil electrolyte additives (GC/MS, HPLC, GPC, FT-IR, IR Microscope, FT-UV/Vis, gel content measurement etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic Analysis</td>
<td>Inorganic fillers for cable material, alien substances in copper foil/rod, heavy metals (Cd, Pb, Hg, Cr) in cable products/materials (ICP-AES, EDS, WD-XRF)</td>
</tr>
<tr>
<td>Thermal Analysis</td>
<td>Blend ratio in cable materials, cross-linking properties of high voltage electric wire insulation, decomposition properties of insulation material, hardening properties of ACF (DSC, TGA, TMA, DMA, RDA)</td>
</tr>
<tr>
<td>Surface Analysis</td>
<td>Surface morphology of copper foil, plating shape, external of conductor, inner shape of optical fiber (FE-SEM, SEM, EPMA, XRD, Optical Microscopy, Scanning Acoustic Microscopy, 3-D color laser digital spectroscopy)</td>
</tr>
<tr>
<td>Structural Analysis</td>
<td>Metal structure, crystallinity of polymer materials (Thermal Conductivity Analyzer, Hardness testing machine, Automatic hydrometer, Surface Area Analyzer, Pore Size Analyzer)</td>
</tr>
<tr>
<td>Environmental Analysis</td>
<td>Assessment for environmental hazardous substances such as Cd, Pb, Cr6+, Hg and PBBs/PBDEs in electronic and electric products (ICP-AES, UV-Vis, GC/MS)</td>
</tr>
<tr>
<td>Physical Property Measurement</td>
<td>Heat transfer properties of materials (elastomer etc.), particle size &amp; pore size of fillers (UTM, High resistance meter, Dielectric property measurement meter etc.)</td>
</tr>
</tbody>
</table>
**R&D Capability**

**Material Innovation**

- Environmentally friendly LF-PVC and LSZH FR compounds
- Recyclable HF-PP compound
- High heat resistance HF-TPEE compound

**Processing Development**

- Polymer compounding technology
  - Internal mixing, twin screw extrusion
- Cable extrusion technology
- Polymer foaming, cross-linking technology

**Material Evaluation**

- Fire performance
- Mechanical, thermal, electrical, and rheological properties
- Chemical analysis
LS Cable are ready to provide our customers with best products and Solutions.

Total Solution Provider, LS
Always with Our Customers, LS
Leading Solution, LS

Thank You