Work Shop Rio Madeira
(17th ~ 18th March)

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Welcome to LS Group

1. Group History
2. LS Group Overview
LG has been divided into three groups, LG, LS and GS based on their business specialties in March, 2005.

- **LG Electronics & Chemical**
  - LG Electronics
  - LG Chem
  - LG Philips LCD
  - LG Telecom

- **Industrial Electric Electronic & Material**
  - LS Cable
  - LS Industrial Systems
  - LS-Nikko Copper
  - LS Mtron
  - Gaon Cable
  - E1 & Yesco

- **Energy & Retail**
  - GS Caltex
  - GS Retail
  - GS E&C
  - GS Home-Shopping
2. LS Group Overview

“Your No. 1 Creative Partner”

With major companies such as LS Cable, LS Industrial Systems, LS-Nikko Copper, Gaon Cable, E1 and Yesco, LS consists of 19 affiliates in total, all known in the field of the industrial electric-electronic and material business.

LS Group Total Sales: 20 billion USD
LS Cable Sub-Group Total Sales: 9 billion USD
Welcome to LS CABLE

1. Business Overview
2. Business Area
3. LS Cable Network
1. Business Overview

**Status (2008)**

- Employees - 5,000 (R&D Engineer 500)
- Sales – 9 Billion USD
- Asset - 8 Billion USD
- 7 affiliated companies
- The largest Korean cable maker (market share 47%)
- World No. 3 Cable maker

**Business Domain**

- **Power Cable**
  - Extra-High Voltage Cable
  - Medium & Low Voltage Cable
  - Overhead Transmission Line
  - Special Rubber Cable
  - Busduct, Industrial Rubber

- **Telecommunication**
  - Cable
  - Solution

- **Copper & Aluminum Products**

- Special wire & cable
2. Business Area

**Power Cable Product**
- XLPE Cable up to 500kV
- OF Cable up to 500kV
- Submarine Cable
- Accessories for EHV Cables
- DTS/DRS surveillance Systems
- HTLS Conductor
- OPGW
- Electronic Wire & Cable
- Shipboard & Offshore Cable
- Busduct
- Industrial Rubber

**Telecommunication Product**
- Solution
  - FTTH, HFC, RF, WiFi, PLC
- Cable
  - Fiber Optic, Fiber Optic Cable
  - LAN Cable, Coaxial Cable
2. Business Area

Copper & Aluminum Products

- SCR
- Magnet Wire
- Aluminum Materials
  (Casting, Extrusion)

Special wire and cable

- Electronic wire & cable
- Automotive wire & cable
- Tube
2. Business Area

Providing Best Solutions for Various Applications

- Power Transmission & Distribution
- Wind Power
- Railway & Rolling Stock
- Marine & Offshore
- Automotive
- Airport (New Package)
3. LS Cable Network

Network - Domestic

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**Headquarters**

- Production
  - Industrial cable & module
  - Automotive wire & cable
  - Tube components
  - Busduct system
  - Rubber tiles

**Anyang Plant** (151,800 m²)

- Production
  - Submarine power cable
  - Industrial specialty cable

**R&D Center** (R&D Man Power 250 Engineers)

**Donghae Plant** (112,331 m²)

- Production
  - Optical fiber, Optical fiber cable
  - Aluminum materials

**Indong Plant** (273,900 m²)

- Production
  - Power cable system (HV/ MV)
  - OHTL, OPGW
  - Magnet wires, Copper rod
  - UTP, RF

**Gumi Plant** (250,800 m²)

- Production
Production

**LSCW**: Automotive wire & cable, Busduct, Electronic wire & cable, HV Accessories

**LSCT**: Magnet wire

**LS-VINA**: Extra-high voltage cable, ACSR, OPGW, SCR

**LSCV**: Medium & low voltage cable, UTP

**LSCM**: Magnet wire

**LSCI**: RF feeder cable
Network - Branches

9 branches in 8 countries

- Russia Office
- Slovakia Office
- UAE Office
- Japan Office
- India Office (New Delhi)
- India Office (Mumbai)
- Singapore Office
- Saudi Arabia Office
- Brazil Office
Network – Superior Essex

4 telecommunication & 19 metallic wire Factories in 9 countries

- Kendallville, Indiana USA
- Willowbrook, Illinois USA
- Fort Wayne, Indiana USA
- Simcoe, Canada
- Franklin, Indiana USA (Femcoe IV)
- Clifton Park, New York USA
- Tarboro, North Carolina USA
- Chester, South Carolina USA
- Atlanta, Georgia Headquarters
- Franklin, Tennessee USA
- Columbia City, Indiana USA
- Torreon, Mexico
- Brownwood, Texas USA
- Hoisington, Kansas USA
- Huyton Quarry, UK
- Arolsen, Germany
- Bramsche, Germany
- Viana de Castelo, Portugal
- Macon, France
- Quattordio, Italy (2 Facilities)
- Mayzieu, France
- Tianjin, China
- Suzhou, China

- Communications Cable
- Magnet Wire and Distribution
- Copper Rod
OPGW (Optical Ground Wire)

1. OPGW System Overview
2. Product Portfolio / Optical Fiber
3. Product Portfolio / OPGW
4. Case Study for IE MADEIRA PJT
5. Type Test Certificate
6. Facilities & Annual Capacity
7. Turn-key Project Capability
8. Experience
1. OPGW System Overview

OPGW system makes a nationwide communication network possible based on the overhead systems used to transmit power.
All kinds of optical fiber produced and applied for various systems.

<table>
<thead>
<tr>
<th>Premise</th>
<th>Access</th>
<th>Metro</th>
<th>Long haul</th>
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</thead>
<tbody>
<tr>
<td>Last 1 mile</td>
<td>Central Office</td>
<td>Metro Ring 50 to 200km</td>
<td>Long Haul 200 to 1,000km</td>
</tr>
<tr>
<td>Campus to 20km</td>
<td>Access Ring</td>
<td>Central Office</td>
<td></td>
</tr>
</tbody>
</table>

- Conventional SMF
- MMF (Multi Mode Fibre)
- Gigabit MMF
- LWPF SMF
- Ultimate Low PMD SMF
- New NZ-DSF
- Conventional SMF
- DSF (Dispersion Shifted Fibre)
- NZ-DSF (Non Zero - DSF)
- POF (Plastic Optical Fibre)

10 G MMF

Giga bit MMF
Various types of OPGW can satisfy overhead T/L system’s requirements.

- **Optical fiber unit**
  - Low optical attenuation
  - Protection from moisture & vibration
  - Stress free structure to temperature & tension

- **Al-alloy tube**
  - Impact resistance & crushing stability
  - Second protection from moisture & Hydrogen

- **Al-clad steel wire / Al-alloy wire**
  - Protection from lightning & Fault Current
  - High strength & anti-corrosion

- **Plastic Loose-Buffered OPGW**
  - Compactness and light weight
  - Excellent tensile performance and strong resistance against lateral pressure and high temperature.

- **Stainless-steel Tube OPGW**
  - Compactness and light weight
  - Al-covered optical fiber unit is available to improve corrosion resistance.
  - High fiber count to 288 fibers
  - Stress free structure to temperature & tension
  - Impact resistance & crushing stability
  - Compactness and light weight

- **Al-clad steel wire / Al-alloy wire**
  - Protection from lightning & Fault Current
  - High strength & anti-corrosion

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  - Low optical attenuation
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- **Al-clad steel wire / Al-alloy wire**
  - Protection from lightning & Fault Current
  - High strength & anti-corrosion

Stainless-steel Tube (SSLT) OPGW is easily connected to the conventional ground wire.
4. CASE STUDY

IE MADEIRA OPGW PJT

**Project Summary**
- Transmission Line Voltage: ± 600kV DC
  - Porto Velho SE ~ Araraquara SE
- Line Length: 2,375km

**Technical Condition**
- Optical Parameter
  - No. of Fiber Optic: 36 Fibers
  - Type of Fiber Optic: G.652 or G.655
- Technical Parameter
  - Max. diameter: 13.4mm
  - Max. weight: 682kg/km
  - Min. RTS: 9,477kgf
  - Short Circuit Current Level: 8kA².sec
  - Lightning Condition: 150°C, 0.5sec

**Risk Consideration**

**Lightning Resistance of OPGW**

**Solution**
- Use of Aluminum-Clad Steel Wire over 3.0mm
- If needed, Galvanized steel wire over 3.0mm could be used
- Time needed between sagging and splicing works at least 3 days to minimize the residual tension of OPGW
- Use of Aluminum-Clad Stainless Steel Tube instead of Bare Stainless Steel Tube
### Aluminum covered stainless steel tube OPGW satisfying requirements.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Required</th>
<th>LSC Proposal</th>
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<tr>
<td>OPGW Type</td>
<td>–</td>
<td>–</td>
<td>Al–covered SSLT Type</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1/6.6 + 9/3.35</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>20% Al–clad Steel</td>
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<tr>
<td>Construction</td>
<td>–</td>
<td>–</td>
<td>Calvanized Steel</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1/7.0 + 10/3.06</td>
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<tr>
<td>Cross Sectional Area</td>
<td>mm²</td>
<td>103</td>
<td>AW : 79.3</td>
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<td></td>
<td></td>
<td></td>
<td>Aluminum : 24.6</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Total : 103.9</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>GS : 73.5</td>
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<td></td>
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<td>Aluminum : 28.9</td>
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<td></td>
<td></td>
<td></td>
<td>Total : 102.4</td>
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<tr>
<td>Fiber Count</td>
<td>–</td>
<td>36</td>
<td>36</td>
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<tr>
<td>Max. Diameter</td>
<td>mm</td>
<td>13.40</td>
<td>13.30</td>
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<tr>
<td>Max. Weight</td>
<td>kg/km</td>
<td>682</td>
<td>597</td>
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<tr>
<td>Min. Rated Tensile Strength</td>
<td>kgf</td>
<td>9,477</td>
<td>9,530</td>
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<tr>
<td>Calculated D.C resistance</td>
<td>ohm/km</td>
<td>–</td>
<td>1.08</td>
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<tr>
<td>at 20degC</td>
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<td>2.74</td>
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<tr>
<td>Min. Short Circuit Current Capacity</td>
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<td>50.7</td>
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<tr>
<td>Lightning Resistance</td>
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<td>150C, 0.5sec</td>
<td>Residual strength</td>
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<td></td>
<td></td>
<td>75% RTS</td>
<td>More than 75% RTS</td>
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<tr>
<td>Cable Cross Sectional Drawing</td>
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<td></td>
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<tr>
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</tr>
</tbody>
</table>
5. Type Test Certificate

The type tests for OPGW was successfully completed based on International Standards (IEC, IEEE) at Kinectrics Inc. in Canada.

- Certification of Type Test:

  **CHESF OPGW 14.8mm, 24Fibers**
  **Lightning Resistant OPGW 14.8mm, 24Fibers**
OPGW as well as optical fiber including a solid pre-form rod are manufactured and supplied with the largest amounts.

**OPGW Manufacturing Facilities**

<table>
<thead>
<tr>
<th>Process</th>
<th>Facilities</th>
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<tbody>
<tr>
<td>S/Z Stranding</td>
<td>S/Z Stranding M/C: 2 Lines (an exclusive OPGW line)</td>
</tr>
<tr>
<td>Aluminum Extrusion &amp; Cladding</td>
<td>Conform M/C: 2 Lines</td>
</tr>
<tr>
<td></td>
<td>- Aluminum extrusion: 1 Line</td>
</tr>
<tr>
<td></td>
<td>- Aluminum cladding: 1 Line</td>
</tr>
<tr>
<td>Stainless-Steel Welding</td>
<td>Laser Welding M/C: 2 Lines</td>
</tr>
<tr>
<td>Metallic Wire Drawing</td>
<td>Drawing M/C: 4 Lines</td>
</tr>
<tr>
<td></td>
<td>- Drawing for Al-cladding: 3 Lines</td>
</tr>
<tr>
<td></td>
<td>- Drawing for Al-alloy: 1 Line</td>
</tr>
<tr>
<td>Metallic Wire Stranding</td>
<td>Stranding M/C: 5 Lines</td>
</tr>
<tr>
<td></td>
<td>- Planetary Type : 4 Lines</td>
</tr>
<tr>
<td></td>
<td>- Tubular Type : 1 Line</td>
</tr>
</tbody>
</table>

**Annual Production Capacity / Year**

- **OPGW**: 12,000 cable. km
  (300 k Fiber. km, 24 Fiber basis)
LSC can build a overhead networking with turn-key project capability utilizing its products and services.

**Products**

- Cable (OPGW & Non-metallic Optical cable)
- Associated Tower Fittings & Line Acc’y
- Optical Test Equipment
- Installation Tool & Equipment

**Service**

- Turn-Key Project
  - Engineering
  - Procurement & Construction
- Engineering Service
  - Optical system design for Overhead Transmission Line
  - Overhead Transmission Construction design
- Installation Training and Supervision
- Installation by Experienced Crews (Full Live-line or Off-line)

**Total Solution for OPGW System**
7. Turn-key Project Capability

**Increase of Telecommunication Network**
- Telecommunication by power utility companies
- Active internet market
- Demands for replacement of existing G/W to OPGW.

**Bad Surrounding Installation Condition**
- Insufficiency of electric power capacity.
- Obstacle under right of way.
- Limited operational space (Engine/Drum field)
- Crossing over other distribution lines
Replacing the existing ground wire by OPGW without power outage on double circuit transmission line

PROCEDURE

1. Preparation
2. Installation of Supporting rollers
3. OPGW stringing
4. Turn-over & Sagging
5. Retrieval of Support rollers and the disconnecting rope
6. Jointing & Testing

7. Turn-key Project Capability

Live-line Installation

Live-Line (Live-Line.exe)
7. Turn-key Project Capability

**Live-line Installation**

**TNB/Malaysia**
Malaysia/TNB 230kV Project: 720 C.km, 2004

**BPC/Bhutan**
Bhutan/BPC 230kV Project: 398 C.km, 2005

**PGCIL/India**
India/PGCIL 400kV E/R, W/R, PDT Project: 8,231 C.km, 2001~2003
8. Experience

Supply of OPGW more than **46 Countries** with **74,071 cable.km**.

Ready to Deliver High Qualified Products and Technology to the Customer.
### 8. Experience

#### South America

<table>
<thead>
<tr>
<th>YEAR</th>
<th>COUNTRY</th>
<th>CUSTOMER</th>
<th>PROJECT NAME</th>
<th>FIBERS NO.</th>
<th>Q'TY (km)</th>
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</thead>
<tbody>
<tr>
<td>1998</td>
<td>BRAZIL</td>
<td>COPEL</td>
<td>138kV Lino – Vera Curuz – Jardim T/L</td>
<td>36</td>
<td>240</td>
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<td>1999</td>
<td>BRAZIL</td>
<td>COPEL</td>
<td>138kV T/L</td>
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<td>142</td>
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<td>1999</td>
<td>BRAZIL</td>
<td>CHESF</td>
<td>500kV Teresinall–SobralIII&amp;230kT Teresina I-Piripiri</td>
<td>24</td>
<td>375</td>
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<tr>
<td>2000</td>
<td>COSTA RICA</td>
<td>ELECTRONORTE</td>
<td>500kV T/L Miranda – Sao Luis230kV Sao Luis I</td>
<td>24</td>
<td>134</td>
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<td>2001</td>
<td>URUGUAY</td>
<td>UTE</td>
<td>230kV T/L, LAT Terra – Montevideo</td>
<td>24</td>
<td>260</td>
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<tr>
<td>2001</td>
<td>BELIZE</td>
<td>ITL</td>
<td>115kV T/L, 34.5kV Fiber optic network- Turn-key</td>
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<td>2001</td>
<td>CHILE</td>
<td>NOPEL</td>
<td>220kV T/L, Iquique – Antofagasta line</td>
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<td>2001</td>
<td>BRAZIL</td>
<td>CHESF</td>
<td>230kV CAMACARI II T/L</td>
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<td>2001</td>
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<td>PERU</td>
<td>SPCC</td>
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<td>RALCO PJT</td>
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<td>CHILE</td>
<td>CHELECTRA</td>
<td>CHELECTRA ADDITIONAL PURCHASE</td>
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<td>BAMARI</td>
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<td>EL SALVADOR</td>
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<td>ZTE</td>
<td>CADAFE Phase 1 (115kV, 230kV, 400kV)</td>
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<td>VENEZUELA</td>
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<td>765kV La Arenosa - Yaracuy No.2</td>
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<td>170</td>
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<td>VEDEMECA</td>
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**TOTAL**
LS Cable are ready to provide our customers with best products and Solutions.

Thank You