

Derwent
Top 100
Global
Innovator
2020

Power Transformer



LS ELECTRIC

Power Transformer

Growing into a World's Best from Nation's First

The company serves its customers!

Leading company in the industrial electric, electronic, materials and energy field following its separation from LG in 2003. LS aims to develop into a company that provides its clients with total solutions, contributes to the overall society, and offers a business environment where employees can realize their dreams.

Innovators in industrial electrical and automation systems

LS goes toward a global leading company in the Industrial electric & Automation field, providing customers with the total solution. We provide customers with distinctive and eco-friendly products & Win-Win Strategy in the various fields such as Power Transmission & Distribution ; Electric Equipment ; Automation Equipment & Systems and Smart Grid.





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LS Power Transformer

The power transformer is a static inductive device that can step the voltage up and down to transfer electrical power efficiently. Winding types and methods that offer the least loss were selected using magnetic field analysis, and also used in the LS Power Transformer to ensure high levels of efficiency. Moreover, by selecting the optimal insulating structure through the electric field analysis of insulation between turns, sections, windings and phases, the Power Transformer's electrical stability is achieved. LS fluent analysis technology has enabled the realization of an optimal cooling system, and 3D structure strength analysis has enabled a structural design that can withstand internal mechanical power short-circuits caused by system faults, seismic conditions according to external impacts, and the impact of transportation.

LS Power Transformer factory is equipped with the latest core processor machines, the latest winding machines, high-capacity vacuum heat drying equipment, state-of-the-art cleaning facilities, and has the best test room.



LS is a NEW & LARGE supplier in the Power Transformer Market. That's why LS continues to work longer and harder for you.

As the leading company in Korea's power solutions industry, LS is playing a central role in the national power supply network, based on its reliability and technology. LS's experience of transformer manufacturing and production technologies of over 20 years has enabled us to proudly present the Power Transformer. Now, LS is going to instill confidence in our customers once again.



Over 30 years of experience for electrical solution. (Since 1974)

LS has been walking a single path in the field of industrial electricity / electronics for the past 30 years, and has achieved technological innovations and improved competitiveness through continuous R&D and investments.

Not only 'Latest', but also 'Newest' Technology!

LS Power Transformer does not merely possess the latest technologies, but is the state-of-the-art product equipped with the newest technologies. On top of all the merits that are part of existing systems, the Power Transformer provides a Total Solution with a Network Control System for the benefit of the private consumer as well as commercial power plants.



Trust LS Transformer-Perfect performance

Safety and reliability are of the utmost importance in the power transformer. That is why you need to choose a reliable company. LS's Power Transformer will ensure optimum reliability through stable performance in any given condition.

Strict test make reliable & safe products.

LS conviction, that rigorous testing is the only way to ensure perfectly operational products at industrial sites was also applied to the Power Transformer. If you are concerned with reduced competitiveness caused by maintenance problems and defects, hesitate no more and choose LS.



Professional staffs make your project succeed.

LS, Korea's top engineers will lead you to perfect success on your business with highly trained skills and careful management.

The newest facilities and equipments make faultless products.

LS has constructed an ultramodern factory in an effort to satisfy the diverse demands of its customers. Our clean facilities enable the production of zero-defect products, within which even a single speck of dust is not allowed.



LS always think about efficiency & environment.

LS takes into consideration the global environment that is in harmony with future-oriented technologies. We aim to not only provide economic advantages for our customers through increased energy efficiency, but also to fulfill our social responsibilities through the development of environment-friendly products.

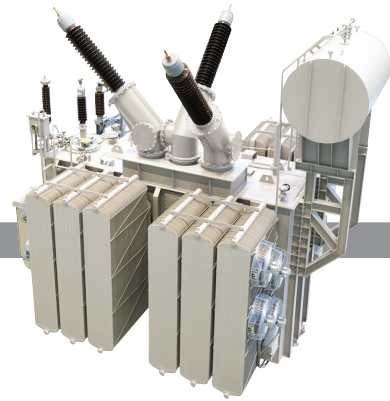
Line-up

LS's power transformers are produced on a clean, zero-defect production line, and come in capacities up to 550kV, 800MVA.

33kV

69kV

132kV



Power Transformer up to 550kV/800MVA

Applicable Standard		IEC 60076 / ANSI(IEEE) C57
Installation Location		Outdoor / Indoor
Frequency [Hz]		50/60
Insulation		Oil type
Thermal Class [°C]		105(A)
Winding Temp. Rise [K]		65
Oil Temp. Rise [K]		60
Cooling Method	Internal	ON / OF / OD
	External	AN / AF / WF
Capacity (MVA)		Up to 800 for Three Phase
		Up to 500 for Single Phase

220kV

400kV

550kV



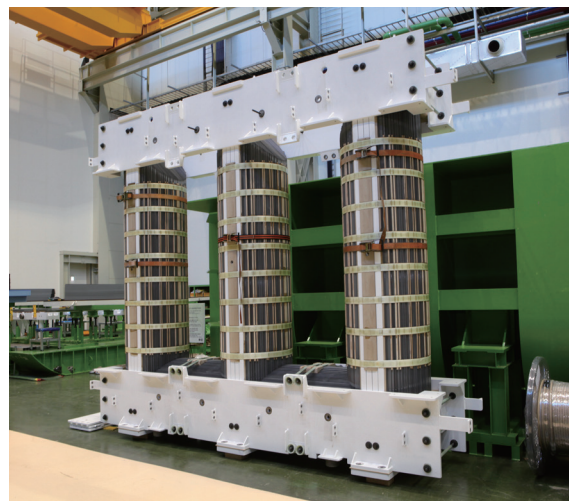
Oil Preservation System	Conservator type N ₂ Sealing type Air Seal Cell type
Base	Skid , Roller
Insulation	Oil type
Application	Generation Plant (GSU) Substation Transmission & Distribution
Special Purpose	Scott Connection Electric Furnace Shunt Reactor HVDC Converter Transformer

※ LS produces and supplies products conform to customer specification as well as IEC & ANSI standards.

Core

Non-aging grain oriented silicon steel sheets with high permeability and low hysteresis loss are used in the construction of cores. They are thinly stratified to reduce Eddy loss, and the joints are arranged with the form of step-lap types to reduce loss and noise.

The thin silicone steel sheets produced by the core's manufacturing equipment are stacked to form magnetic circuits that can generate a magnetic flux. The stacking process cannot be carried out in an upright position due to the thin and large structure of the silicone steel sheets, and is therefore carried out horizontally on a stand. Upon the completion of the stacking process, the top and bottom are supported by a frame Tie-Plates and Glass Resin Tape are wound securely around the core, and then standing upright.



Coil & Winding prevent insulation damage caused by the contraction and expansion that takes place during temperature changes, and the agitation and bending caused by abnormal severe conditions.

The windings are produced by winding pure copper coils of at least 99.9% pure copper around the circular winding machine. The winding machines are separated into vertical and horizontal-types. The vertical type is used for high-voltage, low-current conditions with a small number of conductors and implements a complex winding method. The horizontal type is used for winding methods of a low-voltage, high-current type with a large number of conductors. Winding processes are carried out inside a dustproof room in order to protect it from harmful particles.

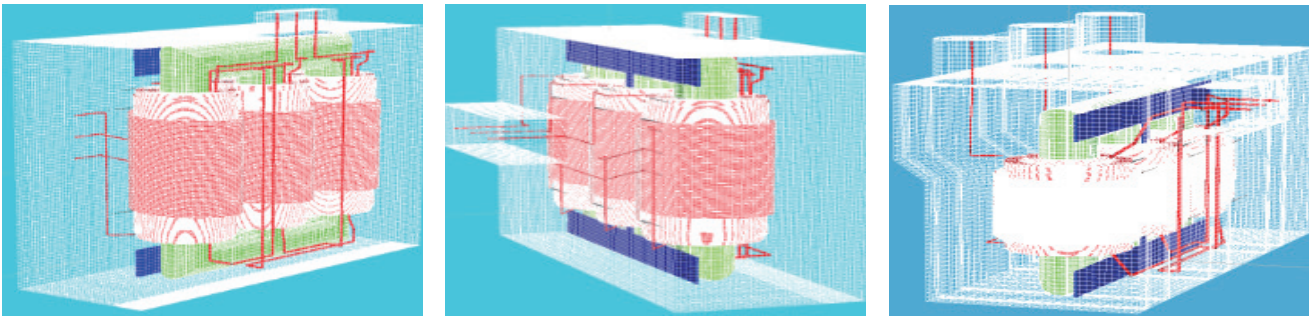


Magnetic Field Analysis

Magnetic fields can be calculated using the 3D Magnetic field analysis, as well as stray losses in structures inside the magnetic fields such as Tank and Frame, and Hot Spot temperatures.

Magnetic Intensity

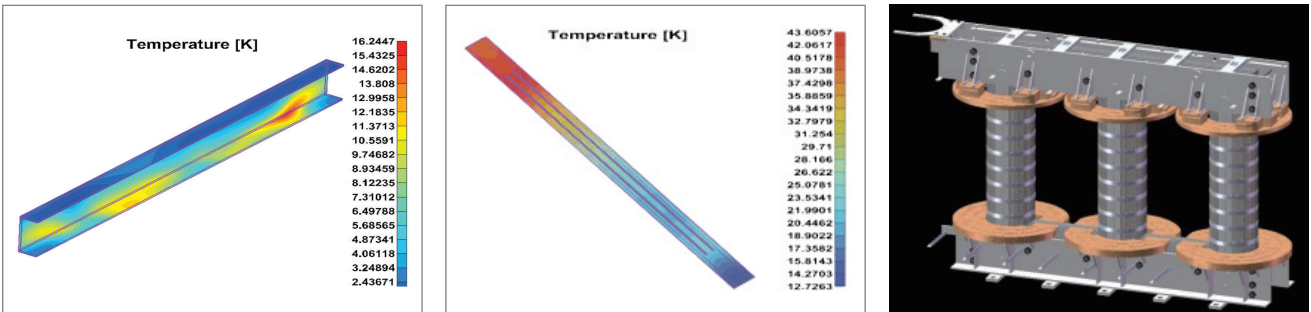
A magnetic field analysis program is used to minimize Eddy current losses that occur in conductors due to magnetic flux. At the ends of the windings, the horizontal component of magnetic flux is high, and in the central parts of the winding, the vertical component of magnetic flux is high. Conductor sizes are differentiated accordingly to minimize Eddy current losses.



Frame Temp. Rise / Tie Plate Temp. Rise

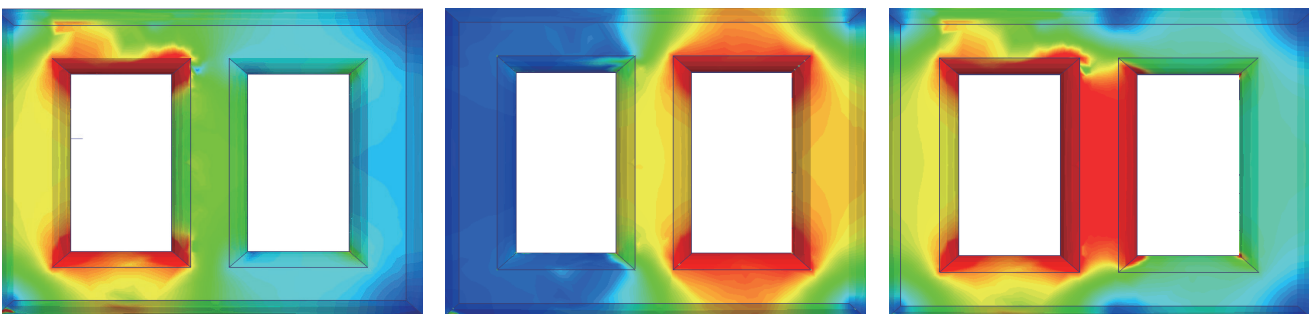
At the design stage, the distribution of leakage magnetic flux in the core-supporting frame is analyzed using 3D modeling.

At the design stage, the distribution of leakage magnetic flux in the leg core-supporting tie plate is analyzed using 3D modeling.



3-D Magnetic Field Analysis

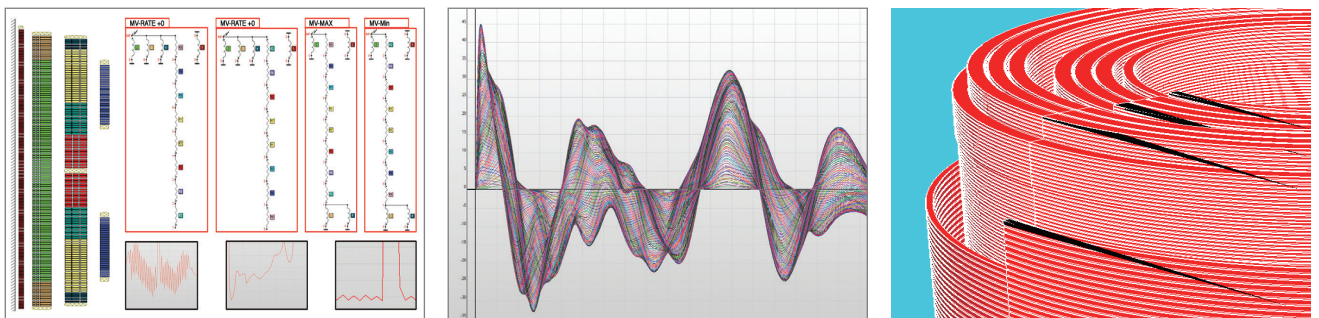
Losses that occur in structures such as the frame or the tank caused by leakage magnetic flux are estimated using the 3D magnetic field analysis program. Adjustments based on the analysis results are made to the frame's structure and dimensions, and magnetic covers such as magnetic shunts are attached to the interior walls in order to minimize losses and temperature rise.



The transient analysis program is used to analyze transient state when applying impulse voltages, and insulation strength between turns, sections and windings. An electric field analysis program is used to analyze the insulation strength at the main gap in the center of the windings and at the end of the windings.

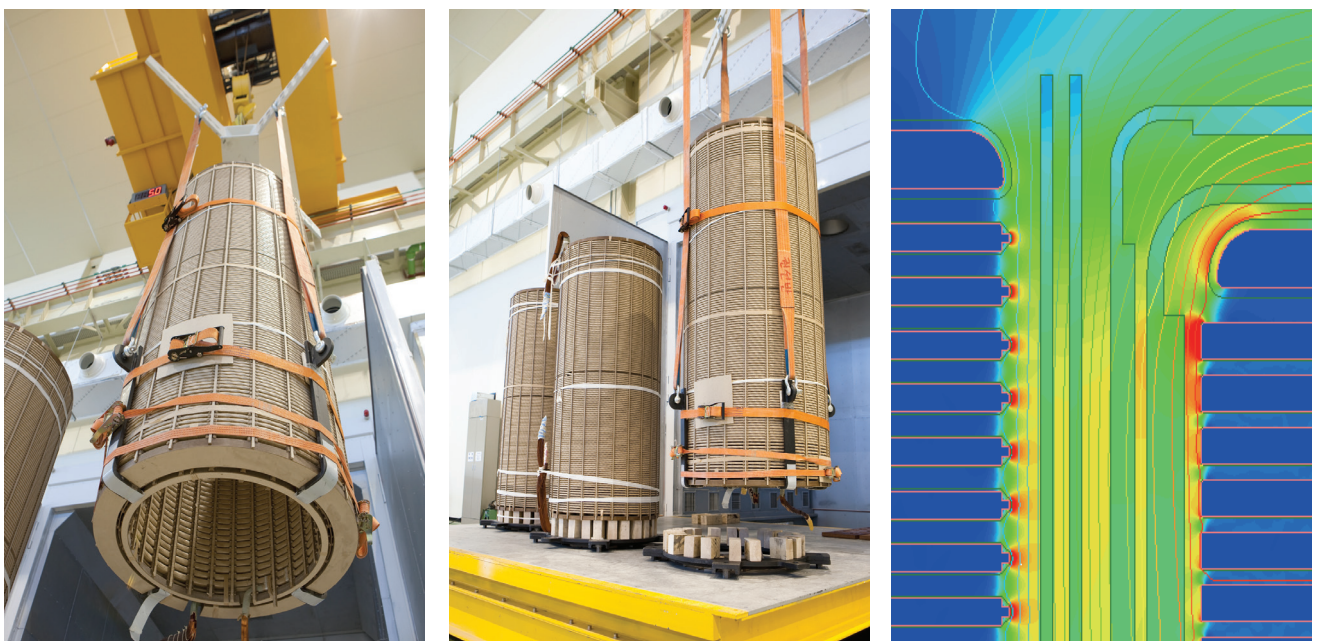
Transient Stage Voltage Oscillation

Using the results from an transient voltage analysis program, the insulation strength between specific sections, electrodes and nodes are examined. By measuring the concentrated electrical field of the insulating materials at the middle and end of the windings, as to whether the insulating structure meets the permitted insulating standards. The results are used in deciding the size and number of the insulating barrier's oil gaps, and in deciding whether angle rings to be inserted. At the ends, where electric fields are concentrated, a static shield ring is inserted to relieve the electrical fields. The series capacitance is increased to improve excessive voltage characteristics, resulting in a safe and compact insulating structure.



Electric Field Analysis

In order to guarantee the transformer's electrical safety margin, an electric field analysis is carried out. 'The LS' design program can replicate the many possible conditions that may arise if the winding is subjected to basic lightning impulses, chopped wave impulses, and switching impulses. The winding's inductance, resistance and capacitance, together with the electric field of the nodes that are distributed along the windings, can be tested using such conditions. The results of the analysis were used in designing an electrically safe device by inserting contra shields at the winding's ends to relieve electric field, and by using interleaved windings. electric fields are concentrated, a static shield ring is inserted to relieve the electrical fields. The series capacitance is increased to improve excessive voltage characteristics, resulting in a safe and compact insulating structure.

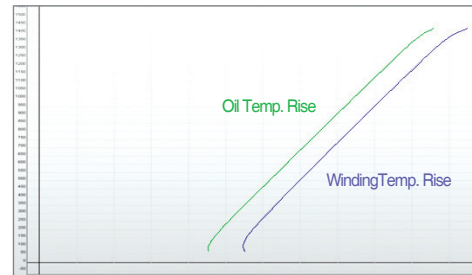
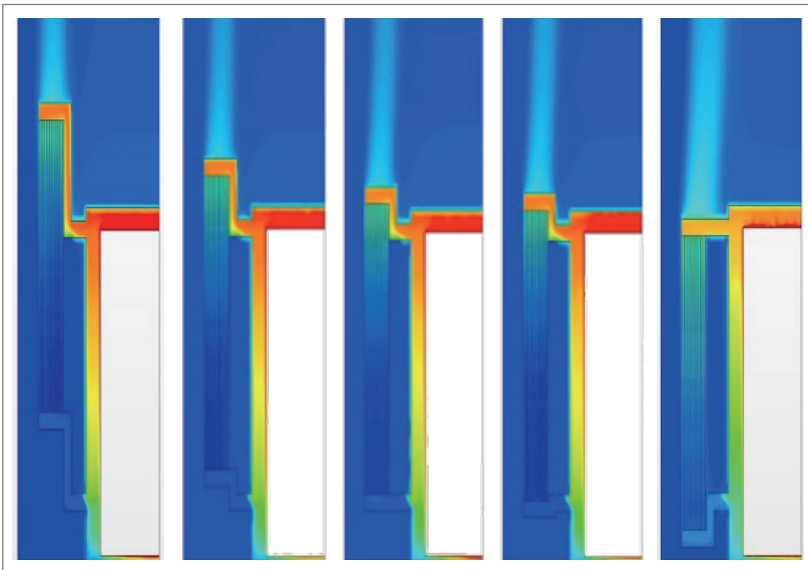


Cooling System Analysis

The cores and the windings are designed for optimal cooling efficiency. They are equipped with large heat-radiating surface areas. Others are equipped with fans and pumps for forced cooling. A program that is capable of applying various parameters, such as radiator surface areas, refrigerant types, size and number of fans and pumps, is used for verification.

Heat Analysis

Losses that occur in structures such as the frame or the tank caused by leakage magnetic flux are estimated using the 3D magnetic field analysis program. Adjustments based on the analysis results are made to the frame's structure and dimensions, and magnetic covers such as magnetic shunts are attached to the interior walls in order to minimize losses and temperature rise.



Distribution of temperatures in coils. Concenter HW, Mode HVRAT

Number of coil	Type of coil	Coordinate of the coil center relative to the lower yoke, mm	Heat flow density, W/m ²	Average coil temperature rise over cooling in the tank, K	Average coil temperature rise over cooling medium temperature, K	Hottest spot temperature rise over cooling medium temperature, K
1	E	1402.868	875.335	18.03207	57.4577	61.30491
2	E	1385.839	853.9028	17.76357	56.78533	60.67418
3	E	1368.81	844.0848	17.69041	56.26829	60.1844
4	E	1351.781	837.8813	17.58958	55.79959	59.73536
5	E	1334.751	833.819	17.54939	55.35953	59.30662
6	E	1317.723	831.04	17.53042	54.93668	58.89472
7	E	1300.693	829.0421	17.52197	54.52435	58.48849
8	E	1283.665	827.5252	17.52004	54.11855	58.08699
9	E	1266.635	826.3065	17.5222	53.71684	57.68844
10	E	1249.607	825.2725	17.52692	53.31768	57.29177
11	E	1232.578	824.3517	17.53326	52.92014	56.89627
12	E	1215.548	823.4989	17.54059	52.52361	56.50154
13	E	1198.52	822.685	17.54854	52.12768	56.10728
14	E	1181.49	822.8913	17.55688	51.73283	55.71391

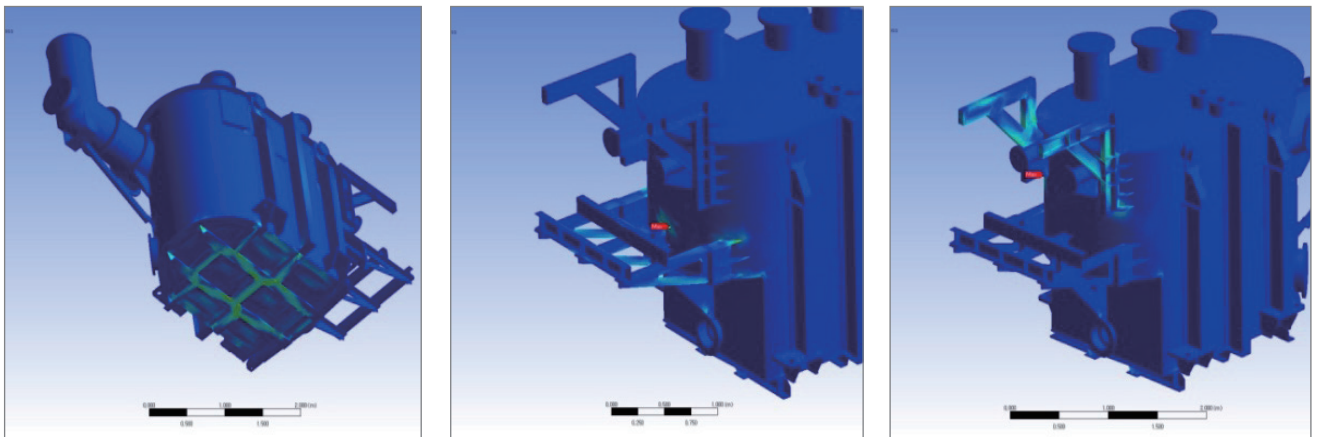
Hottest spot Temp. Rise



The transformer's tank is designed to withstand the impacts and vibrations that occur during its delivery and handling. It is also designed to withstand internal pressures that may arise due to electrical faults. The ANSYS strength analysis program is used to analyse the various strengths of different parts.

Pressure Test Analysis

A program is used to analyse the transformer tank's ability to withstand abnormal internal pressure caused by faults. The tank's mechanical safety is ensured through adding supporting materials to areas that are weak against abnormal internal pressure.



Frame Strength Analysis

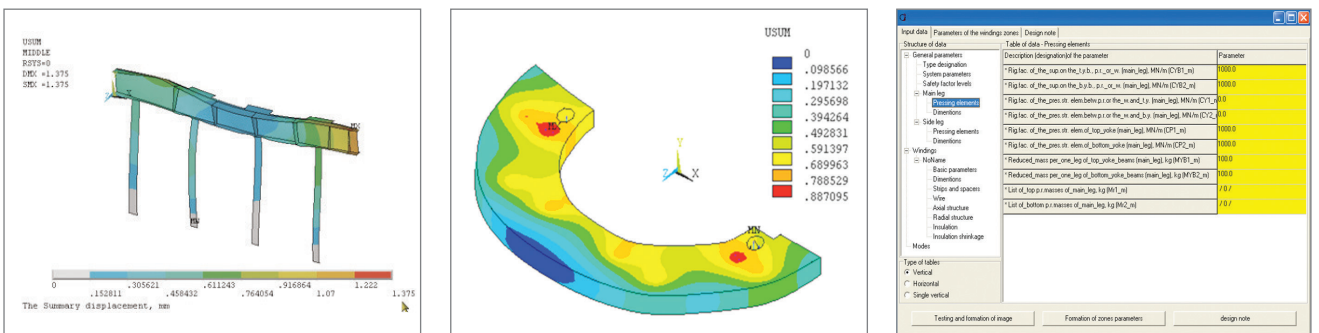
The frame's ability to withstand stress such as short-circuits is analysed using 3D modeling.

Pressure Ring Strength

The pressure ring's ability to withstand stress such as short-circuits is analysed using 3D modeling.

Short Circuit Strength Calculation

A faults mode calculating program is used to calculate the mechanical stress applied to the windings due to faults in the system such as 1-line faults, 2-line faults, 3-phase faults.



Process



Winding

Process for manufacturing winding which flows current by winding the rectangular shaped copper wire (purity over 99.999%) to the cylinder shaped winding machine.



Core Cutting & Punching

The cores are produced by automatically cutting and punching roll-type silicon steel sheets into designed sizes using the program.



Core Stacking & Assembling

The cut silicon steel sheets are stacked to form magnetic circuits that are capable of generating an electric magnetic flux.



Assembling for Main Body

Core and winding are combined together electro-magnetically.



Final Assembling

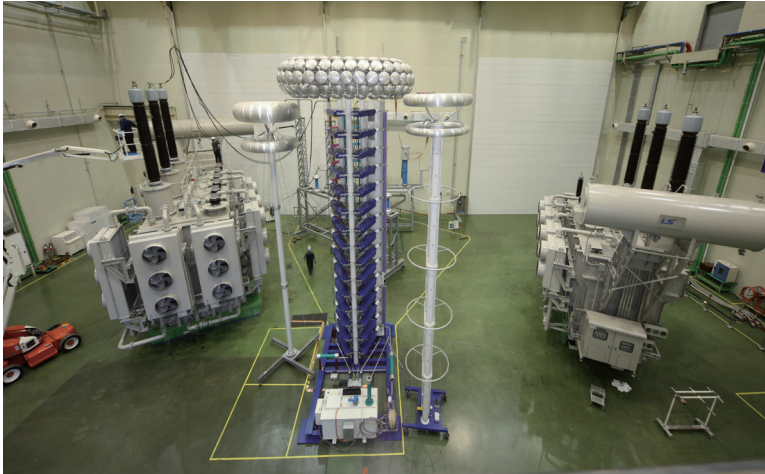
Once the main device is inserted into the tank and the vacuum is achieved, the formation of the electrical circuit is completed by filling the insulation fluid and installing the various supplementary equipment types on the outside of the tank.



Final Testing

Upon completion of the final assembly, the transformer's electrical characteristics and electrical insulation performance is checked through final testing to guarantee its utmost quality.

We possess reliable world-class testing and measuring equipment, and a system that provides our customers with products of the highest quality. Characteristic test, insulation test and temperature rise test that meets international standards such as IEC, ANSI/IEEE, NEMA, KS, and ES.



Routine tests

- a) Measurement of winding resistance
- b) Measurement of voltage ratio and check of phase displacement
- c) Measurement of short-circuit impedance and load loss
- d) Measurement of no-load loss and current
- e) Dielectric routine tests

Type tests

- a) Temperature-rise test
- b) Dielectric type tests
- c) Tests on on-load tap-changers

Special tests

- a) Dielectric special tests
- b) Determination of capacitances windings-to-earth, and between windings
- c) Determination of transient voltage transfer characteristics
- d) Measurement of zero-sequence impedance(s)
- e) Determination of sound levels
- f) Measurement of the harmonics of the no-load current
- g) Measurement of the power taken by the fan and oil pump motors
- h) Measurement of insulation resistance

Testing Equipments

Impulse Test	3000kV 300kJ
AC Withstand Voltage Test	600kV 3000kVA
P.D Meaeurement	ERA/RIV 20kHz-20MHz
M.G set	6.6kV 2400kVA
Loss Meaeurement	200kV 4000A
Resistance Meaeurement	100A 1 $\mu\Omega$ ~ 500 Ω
Condenser Bank	130kV 144MVAR

Definite purpose high voltage transformer

Converter Transformer

It is a special transformer used in HVDC system that changes the existing high voltage AC (HVAC) transmission system to high voltage DC (HVDC) transmission system.

The HVDC system is a high value-added power transmission system that can be used for long-distance power transmission, cable power transmission, asynchronous AC grid connection, grid separation, and large-scale renewable energy grid connection. C-TR is an essential component in this system.

HVDC C-TR is designed and manufactured with advanced technology in consideration of electrical and mechanical specificity such as DC Stress, pole reversal stress, harmonic loss, insulation design and structural design of valve bushing, and cooling design as well as existing AC transformer design elements.

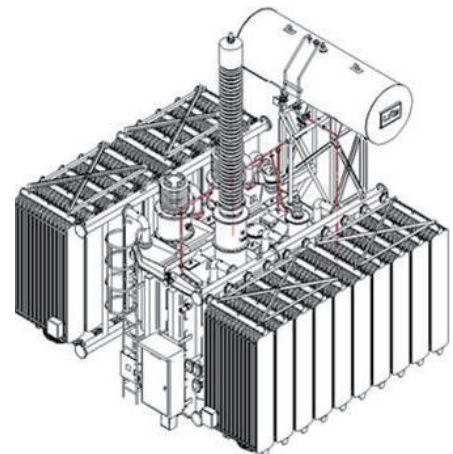


Static Var Compensator Transformer

The SVC transformer is the core equipment of the stationary reactive power compensator which improves the electric quality and stability by supplying or absorbing the reactive power inevitably present in the AC transmission system.

The SVC transformer connects Thyristor Switched Capacitor (TSC) and Thyristor Controlled Reactor (TCR) to the high voltage transmission system to compensate for reactive power.

It is similar to general transformer but it is a special purpose transformer that should be designed to be able to operate continuously for maximum / minimum reactive power compensated operation point.



Scott Transformer

SCOTT transformer is a special transformer that can obtain 2 phase (2 phase, 90° phase difference) output from 3 phase (3 phase, 120° phase difference) power supply.

This transformer is used for special purposes such as when using a large-capacity single-phase load as a three-phase power supply. In Korea, it is mainly used for railway supply line, and 3 phase power is converted into 2 phases and divided into upper and lower lines.

In contrast to a conventional SCOTT transformer consisting of two active parts, LS transformer can be configured as one active part, which has advantages such as compact size, weight and competitive price.



Mobile Transformer



Compact type mobile transformer that can be mounted on the trailer is provided.

Mobile Substation has superior mobility and system flexibility compared to conventional substation and is the best solution for emergency power supply (power outage area) or isolated power supply.

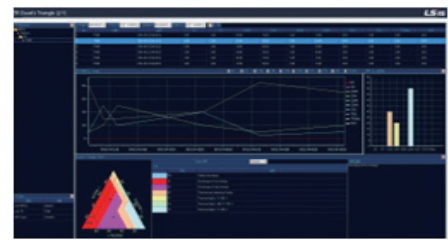
PDPS (Power Equipment Diagnosis & Preventive System)

Through regular monitoring of major power equipment, accidents can be prevented and database management system of

GIS / Tr, Switchgear



PD Diagnosis



Dissolve Gas Analysis

[Work



GIS/TR/ Switchg

1GBps Fiber Switched Ethernet

(DNP3.0 over TCP/IP)

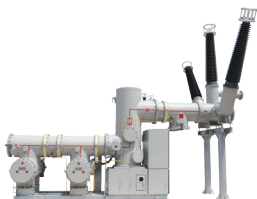
PD DAU



RT DAU



System Rack



UHF PD



Gas-Density



CB Conditio



Lightning Arrester



Dissolve Gas Analysis



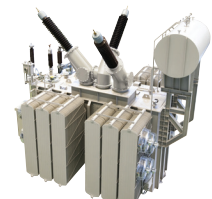
Oil-Temperatur



Oil-level Gauge



Others



GIS Diagnosis

- Partial Discharge (UHF PD)
- SF₆ Gas Density Monitoring
- Analysis of Circuit Breaker operating & Condition
- Cumulative breaking current
- Cable PD Monitoring
- Lightning Arrester leakage current

Transformer Diagnosis

- Oil contained Gas concentration
- Insulated Oil / Winding temperature
- FAN driving current / time
- PUMP driving current / time
- OLTC operating current / time

events and history of each unit support efficient management of power equipment.

Diagnosis HMI

station]



Mold Tr Diagnosis (PD, Temp)



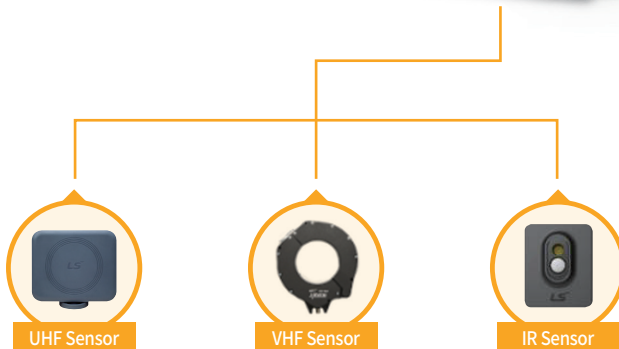
Switchgear Diagnosis (PD, Temp)

ear Diagnosis HMI

100Mbps Switched Ethernet

Protocol based on TCP

SD DAU

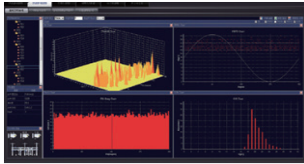


Switchgear Diagnosis

- UHF PD Diagnosis (Inside of the PNL)
- VHF PD Diagnosis (Cable)
- Contactless IR Temp Diagnosis (Phase Temp)
- Contact Temp Diagnosis
- Thermo-graphic Diagnosis

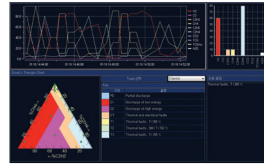
PDPS (Power Equipment Diagnosis & Preventive System)

Major monitoring and Supporting report



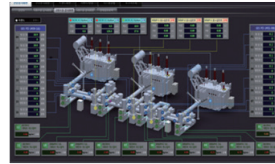
GIS PD Diagnosis HMI

- Upgrade Reliability for using Neural Network / Fuzzy Algorithm
- Visual Diagnosis function providing 2D/3D chart
- PD Pattern by Sensor & Event Filtering Function



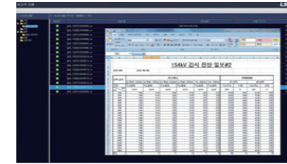
TR Multi-Gas Diagnosis HMI

- TR Degradation Diagnosis Function for using Gas Density
- Easy for using in-put
- Quick search time to be judged immediately enter the gas concentration



GIS & TR Diagnosis HMI

- GIS Partial Discharge
- GIS Gas Density
- Lightning Leakage
- TR Oil- Dissolved Gas
- Abnormal Temperature (Oil Temp / Coil Temp)
- TR .FAN Group (Operating Current /Time)
- OLTC (Operating Current / Time)



Total Diagnosis & Report

- Diagnosis by Sensor & Period
- Day / Month / Year Trend Diagnosis
- Max / Min / Average statistics by Period
- Providing of the Trend data Expansion & Reduction
- Report by Excel Export

CB Mech. Operating Diagnosis



CB operating Diagnosis HMI

- CB operating assessment & specific Wave
- CB braking contact life



- Gas density
- Oil-motor
- Saving & Management of the CB Operating

TR Duval's / Dissolve Gas analysis




TR Multi-Gas Diagnosis HMI

- TR Degradation Diagnosis Function for using Gas Density
- Easy for using in-put



- Quick search time to be judged immediately enter the gas concentration

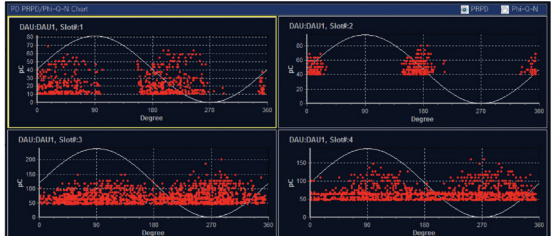
PD Data Diagnosis for Using Neural Network/ Fuzzy Algorithm



GIS PD Diagnosis HMI


- Upgrade Reliability for using Neural Network / Fuzzy Algorithm
- Visual Diagnosis function providing 2D/3D chart
- PD Pattern by Sensor & Event Filtering Function

Multi Channel PD Diagnosis




Switchgear / Mold TR Diagnosis


Switchgear HMI




Mold TR HMI



Neural Network / Fuzzy Algorithm



Temp Trend & Library



Quality Assurance

Flexible and quick delivery is possible through our computerized management using an ERP System and the rigorous ISO 9001 quality control. Moreover, we have obtained the ISO 14001 environmental management system certification for our environment friendly production and after-sales service.

Quality Management

The LS runs a development library that carries out verifications in various sites of conditions, and comparison tests with other companies' products. This is achieving a growing customer satisfaction level through producing high-quality products. Such quality management has earned LS' many certifications and awards, and has become the basis for a realization of products of a global standards.

Customer Technology Training Service

The LS offers the industry's first customer training program through the internal training institute. Factory automation and other Industrial electricity and electronic processes are taught through realistic practice apparatus. Technology advice and guidance are offered through this cutting-edge technological service.

Web-based Customer Service.

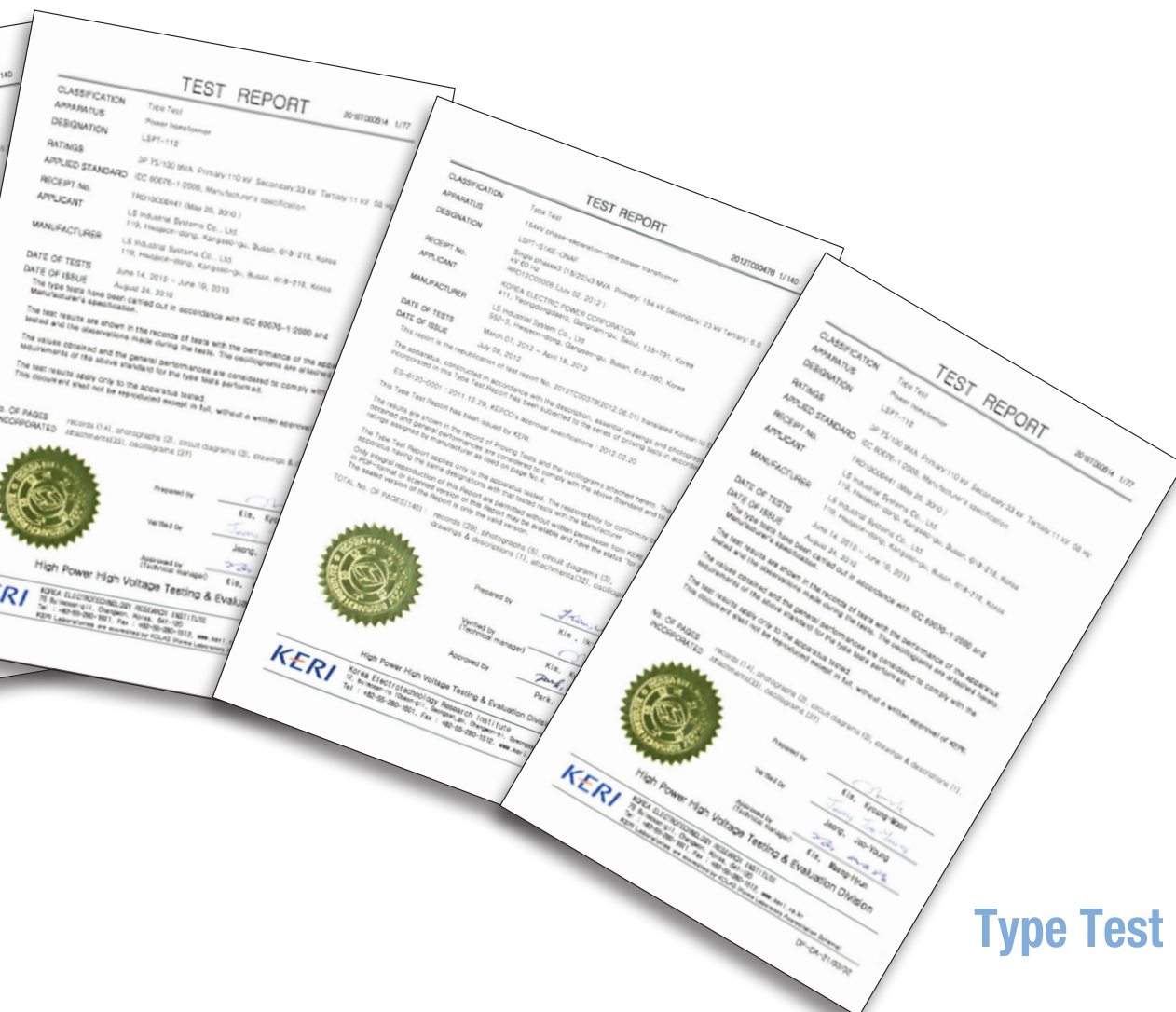
The LS offers globally web-based customer service, aimed at customer satisfaction through providing technological information, quick responses to enquiries, and precise service history. Moreover, by building a supply chain management system-an integrated management for purchasing, production and supply- we are leading the e-business in industrial electrical automation.





PT&T Power Testing & Technology Institute

PT&T is a KOLAS-qualified (Korea Laboratory Accreditation Scheme) accredited testing laboratory and provides worldwide testing service with its 1,600MVA-capacity high power laboratory, high voltage laboratory and reliability testing laboratory.



Type Test Report

Check List

Item	Content			
Applicable Standard	<input type="checkbox"/> IEC	<input type="checkbox"/> ANSI	<input type="checkbox"/> etc	
Phase	<input type="checkbox"/> 1 phase	<input type="checkbox"/> 3 phase	<input type="checkbox"/> etc	
Place of Installation	<input type="checkbox"/> indoor	<input type="checkbox"/> outdoor		
Loading	<input type="checkbox"/> general-load	<input type="checkbox"/> etc		
Condition of Installation	<input type="checkbox"/> new-installation	<input type="checkbox"/> extension	<input type="checkbox"/> parallel-operation	
Frequency	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz		
Cooling Type	<input type="checkbox"/> ONAN	<input type="checkbox"/> ONAF	<input type="checkbox"/> etc	
Capacity	<input type="checkbox"/>	/	/	
Rated Voltage	<input type="checkbox"/> Primary kV	<input type="checkbox"/> Secondary kV	<input type="checkbox"/> kV	
Tap Changer	<input type="checkbox"/> DETC	<input type="checkbox"/> OLTC	<input type="checkbox"/> etc	
Tap Range	<input type="checkbox"/>			
Earthing Method	<input type="checkbox"/> direct	<input type="checkbox"/> resistance	<input type="checkbox"/> arrester	<input type="checkbox"/> etc
Connection	<input type="checkbox"/> Y-D	<input type="checkbox"/> D-Y	<input type="checkbox"/> D-D	<input type="checkbox"/> etc
Winding / Oil Temp rise	<input type="checkbox"/> Winding	<input type="checkbox"/> Oil		
Impedance	<input type="checkbox"/> %			
	<input type="checkbox"/> top-top	<input type="checkbox"/> top-side	<input type="checkbox"/> side-top	<input type="checkbox"/> side-side
Bushing Withdraw	<input type="checkbox"/> etc			
Additional Demand Item	<input type="checkbox"/>			
Painting	<input type="checkbox"/> LS Standard	<input type="checkbox"/> etc		
Remarks	<input type="checkbox"/>			

Worldwide Experiences



CHINA



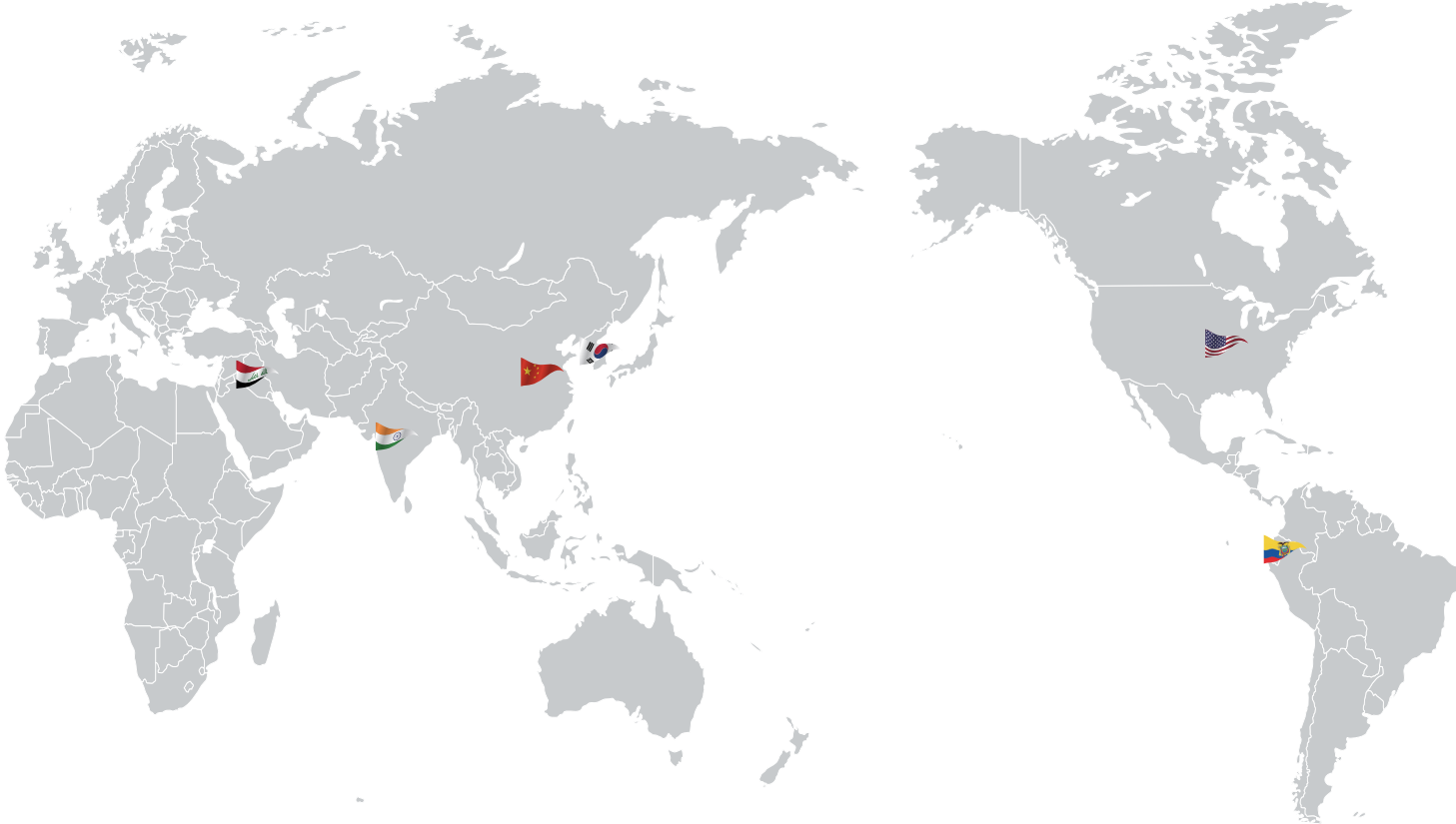
KOREA



USA



USA



IRAQ



INDIA



ECUADOR

Global Management

LS is engaged in business all over the world.
 LS global network includes 7 overseas corporations,
 12 overseas branches, and 224 clients in 77 countries.



► R&D



R&D Campus

Focuses on gaining competitive advantages through development of next generation platforms



Power Device R&D Center

Leading technology in electric industry and continuously developing future-growth dynamic engines



Automation R&D Center

Serves as the main Research Institute for LSIS



PT&T (Testing laboratory)

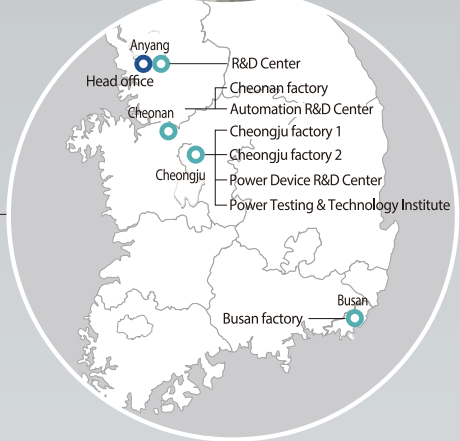
Internationally-renowned testing center that has formed partnerships with the UL, CE, KEMA and CESI

► Factory



Cheongju factory (Korea)

Electric Products, Mold TR, MV/LV Switchgear, HV GIS



Cheonan factory (Korea)

PLC, AC Drive, HMI, DCS, PV Module



Busan factory (Korea)

HV TR, HVDC, FACTS



Wuxi factory (China)

Electric Products



Dalian factory (China)

MV/LV Switchgear,
MV Contactor



Hanoi factory (Vietnam)

MV/LV Switchgear,
Mold TR



Safety Instructions

- For your safety, please read user's manual thoroughly before operating.
- Contact the nearest authorized service facility for examination, repair, or adjustment.
- Please contact qualified service technician when you need maintenance. Do not disassemble or repair by yourself!
- Any maintenance and inspection shall be performed by the personnel having expertise concerned.



- According to The WEEE Directive, please do not discard the device with your household waste.



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