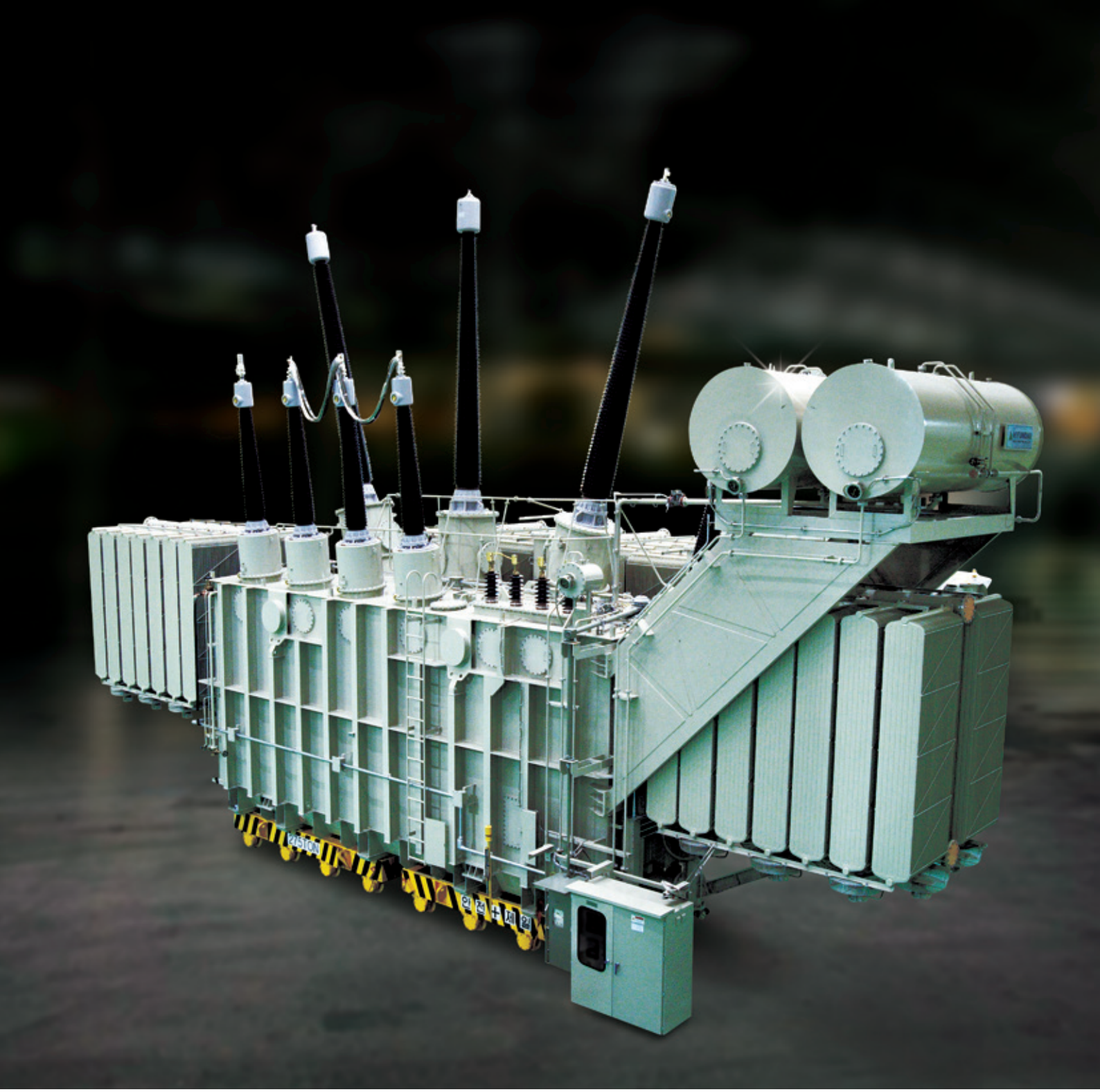


Power Transformers

HYUNDAI
ELECTRIC

HYUNDAI, A RELIABLE BUSINESS PARTNER IN THE POWER INDUSTRY

CONTENTS

Power Transformers

Using cutting-edge designs, state-of-the-art manufacturing facilities, and innovative production technology, we manufacture high-quality power and distribution transformers with a rated voltage of up to 800 kV and a capacity of up to 1,500 MVA. Hyundai transformers are in service around the world and meet international standards such as IEC, ANSI, NEMA, CSA, AS, and ES.

ULSAN FACTORY, KOREA

ALABAMA FACTORY
HYUNDAI POWER TRANSFORMERS USA, INC.

SOFIA FACTORY
HYUNDAI ELECTRIC - BULGARIA

Hyundai Transformers at a Glance

Hyundai Electric, being specialized in design and manufacturing of electrical equipment, has been pursuing the business goal of providing total solution to the customers around the world since its establishment.

We are offering the complete range of electrical equipment for power plants, transmission and distribution, and various industrial sectors such as Transformers, SF_6 Gas Insulated Switchgear, Medium Voltage Switchgear, Motors, Generators, Integrated Control & Monitoring Systems, Power Electronics, etc.

Among such wide range of products, Hyundai Transformers, featuring excellent performance and a high level of reliability proven through a lot of experiences accumulated over a long span of period, have been delivered to the customers and gained good reputation from the customers.

To best serve our clients with global capacity, we are currently operating Ulsan plant in Korea, Alabama plant in the USA and Sofia plant in Bulgaria.

Hyundai Ulsan factory, equipped with the most advanced manufacturing and testing equipment, and having the annual capacity of 120,000 MVA, is manufacturing the whole range of transformers from distribution and power transformers up to 800 kV including cast resin and various kinds of special purpose transformers such as furnace transformers and gas transformers, etc.

Hyundai Power Transformer USA in Montgomery, Alabama is built based on the invaluable experience and cutting-edge technologies gained over 30 years. Hyundai Power Transformer USA strictly follows the procedures that have been tested and proven from Ulsan plant in order to guarantee the production of high-quality power transformers. The new plant is fully capable of providing client-specific power transformers to mostly, but not limited to, North America, South America, and African regions. Always striving to produce innovative and superior power transformers, Hyundai Power Transformer USA is confident in achieving worldwide customer satisfaction.

And Hyundai Sofia factory, with its long experience of more than 50 years in manufacturing transformer and tap changers, has been supplying its products to the customers for power generation, transmission and distribution areas.

Hyundai, having the competitive edges in price, delivery and quality, has become the world leading supplier of transformers over the short span of period since its establishment. We are committed to offer the best service for the customers including after-sales service.

Hyundai has kept total quality system certified by ISO 9001 and we are providing quality products and services for the customers in accordance with their requirements.

Production Range

Being classified by its application, construction and ratings, transformers can be divided into Power Transformer, Distribution Transformer, Reactor, Cast Resin Transformer and Special Transformer.

Production range of Hyundai Transformer fully covers above mentioned transformers and services as follows ;

Transformer Plant	Scope of Production & Services
Ulsan Factory in Korea	- Power Transformer up to 800 kV / 1,500 MVA - Distribution Transformer - Cast Resin Transformer - Dry Type Transformer - Reactor - Special Transformer
Alabama Factory in USA	- Power Transformer up to 500 kV / 600 MVA - Distribution Transformer - Reactor - Special Transformer
Sofia Factory in Bulgaria	- Power Transformer up to 420 kV / 200 MVA - Distribution Transformer - Instrument Transformer up to 145 kV - Special Transformer - Tap Changers such as On-Load Tap Changer, Off-circuit Tap Changer and SF_6 Gas Insulated Tap Changer
Services to be provided by transformer factory	- Supervision of Transformer Installation & Commissioning - Advisory Services of Transformer Specification - Training of Customer Personnel - Inspection & Trouble Shooting Service - Investigation and Assessment of Problems

Power Transformer

Reactor

Cast Resin Transformer

Tap Changer

Transformer Design

By utilizing the most modern and up-to-date design technology, Hyundai provides designs which can meet the customer's various requirements and international or national standards of IEC, ANSI, NEMA, CSA, BS, AS, etc.

Also Hyundai design team has sufficient experiences and proven records which can meet the customer's various needs of power, voltage, mode of operation, low noise level, connection techniques, type of cooling, transport and installation.

Taking into account of any possible case of short-circuit fault which may be incurred in service, we utilize a computer program to calculate accurate radial force, axial force and spacer of winding.

Particularly, Hyundai can perform seismic analysis with the computer program to ensure that the transformer has the capability to withstand the seismic condition.

Core Construction

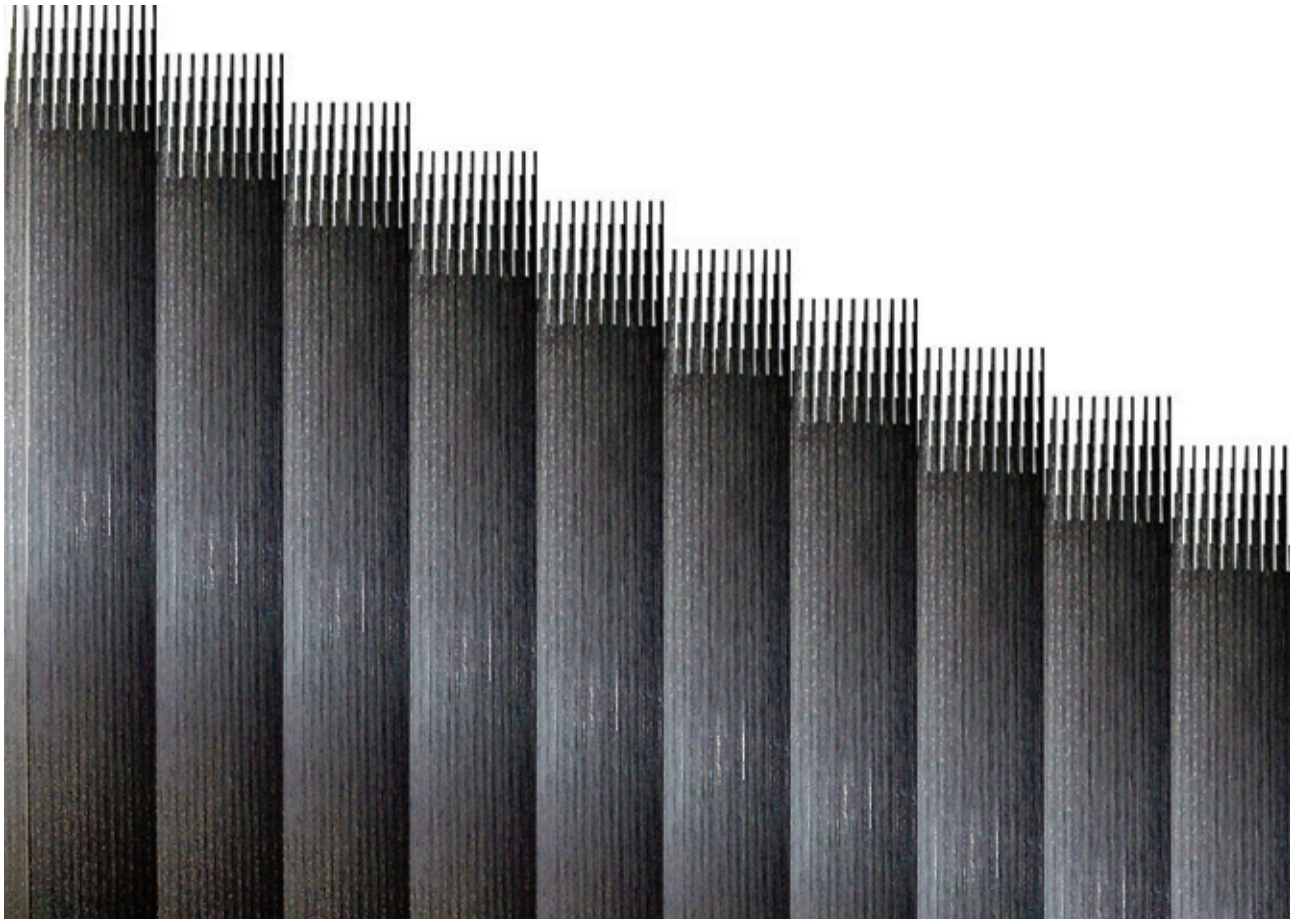
The cores for Hyundai transformers are made of high quality, cold-rolled, grain-oriented silicon steel coated with magnesium-silicate-phosphate.
Laser scribed or plasma treated silicon steel can be used for those require low loss design.

The standard core construction type of Hyundai transformer is 'core form type' having three leg core or five leg core of three phase and two leg core, three leg core or four leg core of single phase according to the customer's special requirement.

In the core of large power transformer, suitable insulation papers are inserted between the laminations for the purpose of reducing eddy currents and also to minimize magnetic short-circuit.

And for the effective cooling, cooling ducts are provided between the core laminations.

The leg core where the hard wooden bars are inserted, are tightened with synthetic resin impregnated glass band.



Step Lap Core Lamination

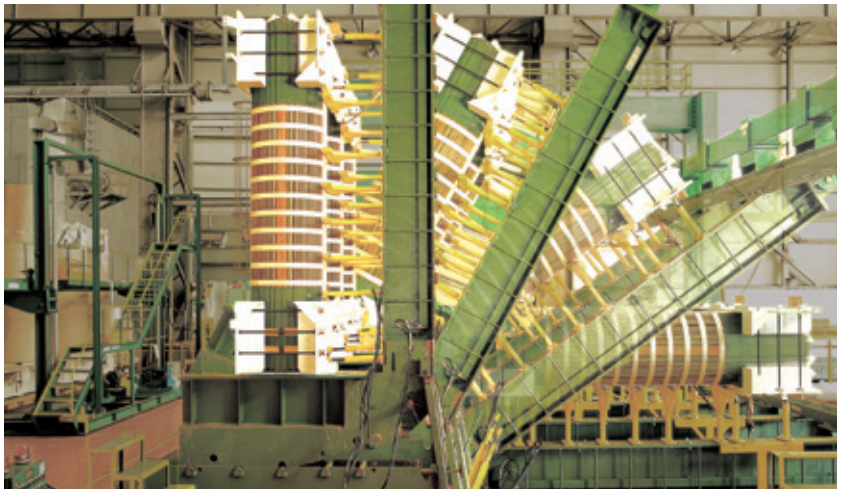
Step lap core lamination is used to reduce no load losses and noise level.

Core Cut-to-length Machine

The oriented silicon steel is cut by computerized machine to minimize air gap in the joint during assembly.

Core Stacking

Five Leg Core stacking



Core Erection Equipment

Special core erection equipment is used for the large core in order to prevent deflection from stress and strain during upright setting of the cores.

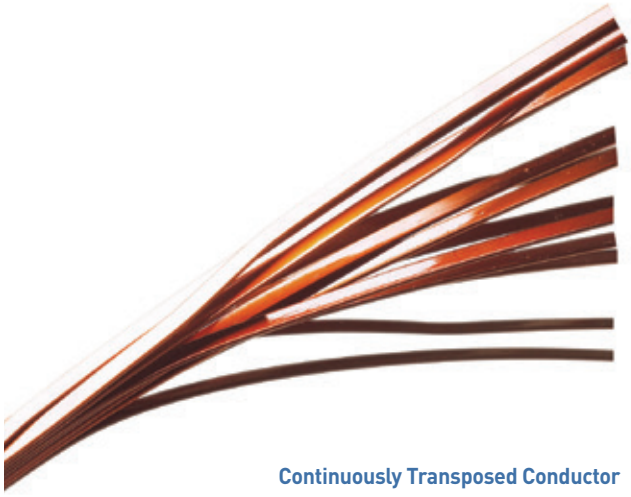
Winding

The winding is made of copper conductor covered with several layers of insulation paper or enamel coating of high dielectric strength. Rectangular conductor, multiple conductor and transposed conductor are employed in the winding. The most optimized conductor is selected after considering the voltage and capacity of the transformer.

Especially, the transposed conductor is composed of several wires individually covered with enamel and this entire wire unit is covered with several layers of insulation paper.

The advantage of using transposed conductor is to decrease eddy current loss in the windings, improve of the lamination factor and manufacture windings within a short time span.

When manufacturing large power transformers, the most suitable winding method is employed according to the capacity, voltage and tap range of each transformer.



Continuously Transposed Conductor

And during the manufacturing process of windings, the following factors are taken into account ;

- Short circuit
- Ability to withstand impulses
- Eddy current loss
- Ability to distribute over-voltage

Horizontal Winding Machine

Vertical Winding Machine

Layer Winding

Applied to low voltage and large current windings

Helical Winding

Employed according to the magnitude of current in case of low voltage winding

Disc Winding

Applied for high voltage winding and classified into continuous and interleaved disc winding

Interleaved Layer Winding

Applied for tap winding

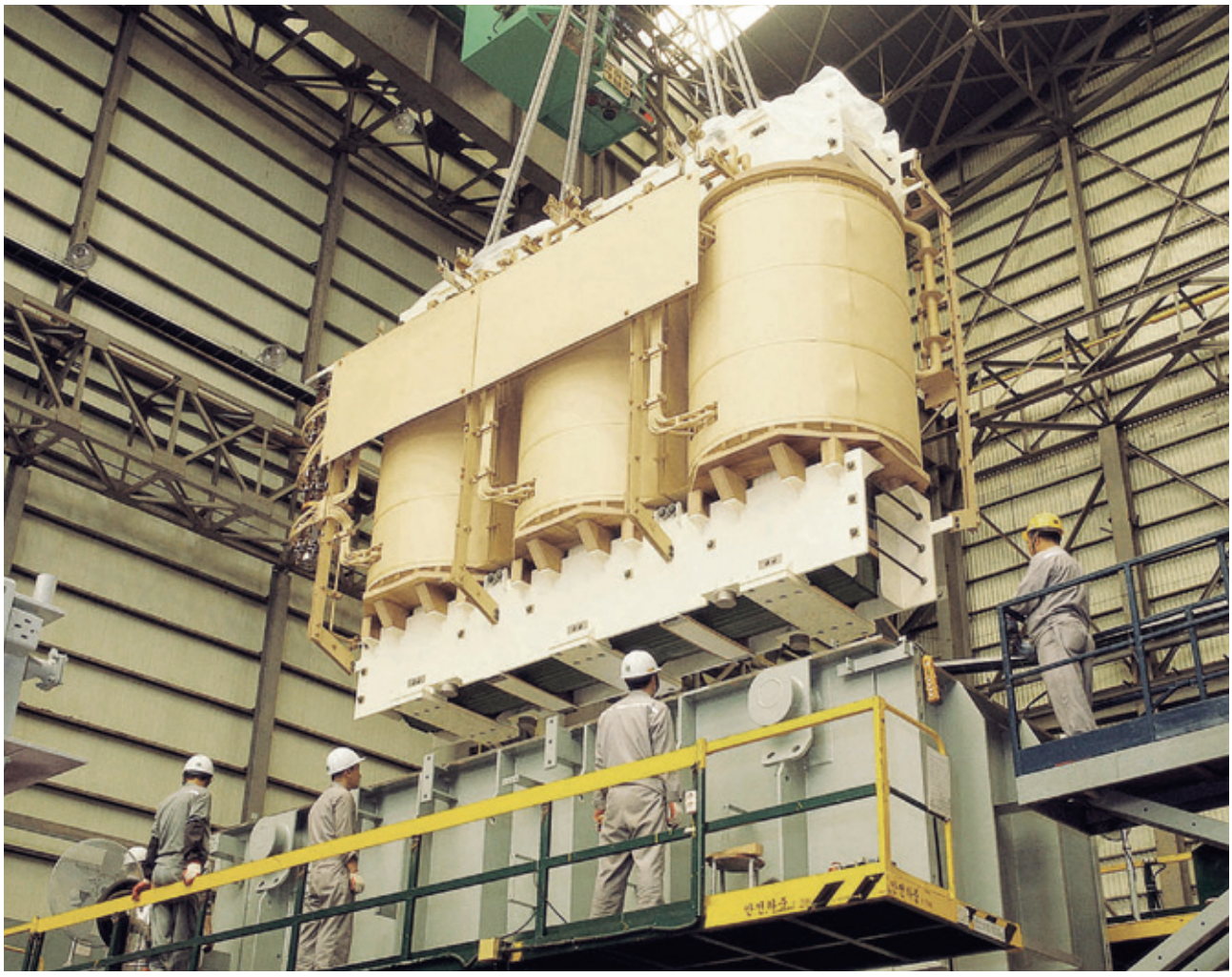
Core & Coil Assembling

For insulation, all Hyundai transformers have a concentric winding structure. One or more insulating cylinders are placed around the core legs. The number of insulating cylinder depends on the voltage stress between the leg and the winding itself.

Vertical spacers are provided to produce an oil duct for the cooling of windings. Between the low and high voltage winding a number of insulating cylinders are provided at fixed distance from each other by using vertical spacers. The high voltage winding is wound on the outer cylinder.

The bottom of the windings rest on the supporting system of the lower yoke. And a large wooden press ring called "pressing wood" is provided at the top of windings. The windings are pressed by means of the pressing wood and bolts on the upper clamp device. All leads and busbar are tightly supported to withstand short-circuit force.

After the core and coil assembly is completed, it will be dried in the vapor phase drying plants under high vacuum condition for the purpose of eliminating moisture content.

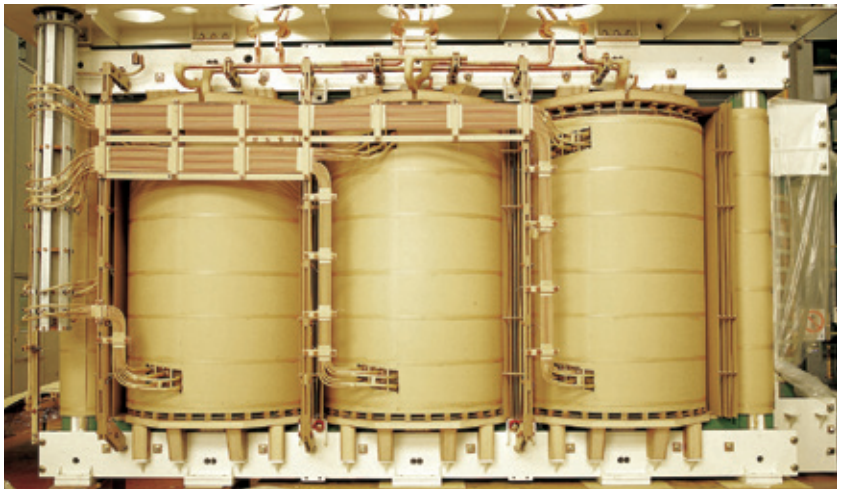


Transformer under In-tanking Process

On completion of the vacuum drying, the core and coil assembly is inserted in the tank.

Winding Inserting

Low voltage winding, high voltage winding and tap winding are inserted into a leg core.



Core and Coil Assembly

Core and coil assembly of the transformer will put the core, windings clamping device, tap changer and lead together.

Vapor Phase Drying Plant

Vacuum drying with heat in vapor phase drying plants.

Tank

Protection of the active parts in the transformer is very important, especially in case of high voltage and large current transformer.

While achieving the optimized size of transformer to suit the site condition for installation, the main role of the tank is to protect the active parts and the tank is manufactured to have sufficient strength to withstand internal and external faults that may occur during operation.

And the various ancillary devices such as lifting lug, jack pad, pulling eye and skid base are designed and provided on the tank so that the transformer can be moved in any direction without damage when using rollers, plates or rails.

Hyundai's strict welding procedure and leak test standard assure 100% leakproof seams and maximum mechanical strength.

After finishing the welding work, it is shot-blasted to remove all dust and spatters before painting.

Non-Destructive Test on Transformer Tank

Painting of Tank

The tank is painted with HHI standard painting system which is poly-urethane resin in order to prevent the tank from any possible corrosion which may appear according to the site condition.

Transformer Tank

The tank is made of high quality mild steel.

Cooling System

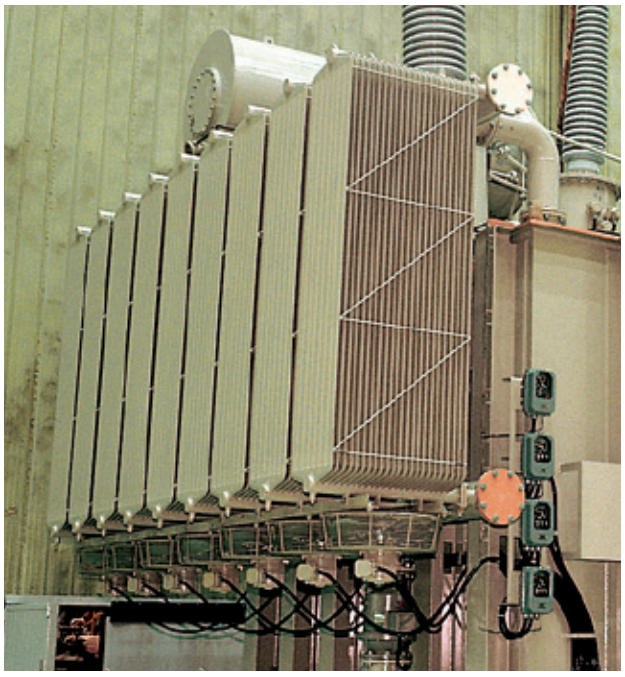
A transformer in service has losses which are transformed in to heat to be dissipated but causing to a temperature rise in the transformer. In order not to allow the temperature to rise above the permissible level, a suitable cooling method should be considered and adopted.

Generally, the suitable cooling method for the transformer is determined by the customer after due consideration of transformer capacity and the circumstances at the installation site.

Hyundai can design and manufacture transformer with various types of cooling systems according to the customer's requirement.

- ONAN: Natural oil cooling (ON), Natural air cooling (AN)
- ONAF: Natural oil cooling (ON), Forced air cooling (AF)
- OFAF: Forced oil cooling (OF), Forced air cooling (AF)
- ODAF: Directed oil cooling (OD), Forced air cooling (AF)
- OFWF: Forced oil cooling (OF), Forced water cooling (WF)

Oil to Air Cooler



Panel Type Radiator

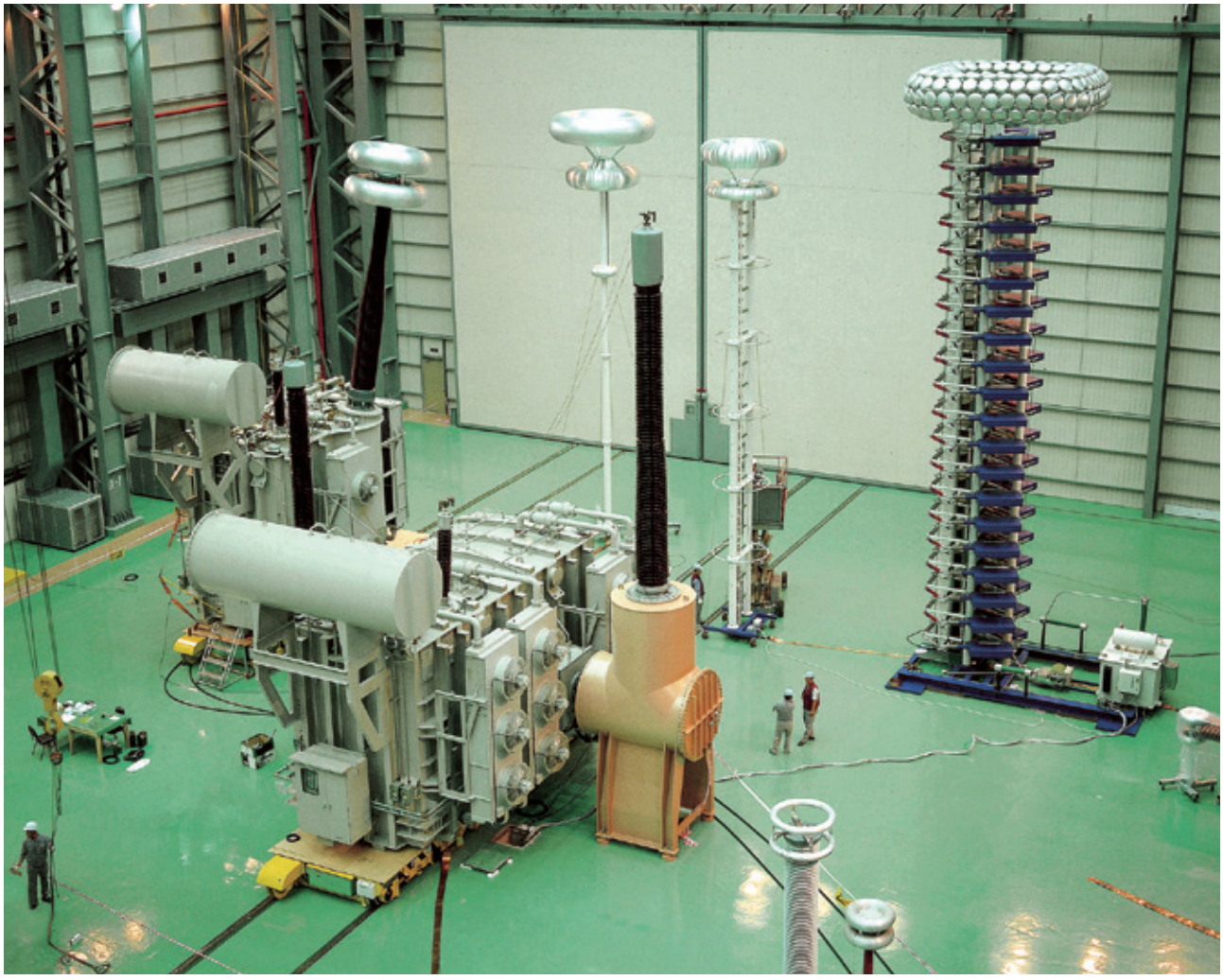
Oil to Water Cooler

Testing

Hyundai Electric, as one of leading electrical equipment manufacturers, has the state-of-the-art testing laboratory which is equipped with the most modernized testing facilities in the world.

In this ultra-high voltage testing laboratory, Hyundai transformers at the system voltage up to 1,000 kV are subjected to the routine and type tests as per the customer's requirements and applicable international standards.

Control Room of Ultra-High Voltage Test Laboratory



Ultra-High Voltage Test Laboratory

Equipped with 4,400 kV impulse generator and 1,200 kV AC generator

Research & Development

Research & Development is an essential requirement for improvement and advance of modern technology.

Hyundai Electric commitment to the research and development has been a motivating factor of the company's various technical achievements and will be vital in its advance into the 21st century.

Hyundai Electric is operating three renowned in-house research institutes: HMRI(Hyundai Maritime Research Institute), HIRI(Hyundai Industrial Research Institute) and HEMRI (Hyundai Electro-Mechanical Institute) as well as an overseas institute (HUNELEC) in Budapest, Hungary.

These institutes are fully equipped with state-of-the-art R&D devices and our top-notch brains are exploring the future of high technology.

Hyundai transformers have been supplied to most of the countries all over the world and their technology, quality and reliable performance have been widely acknowledged by the customers around the world.

Quality Assurance

It is the policy of Hyundai Electric that the products shall meet the customer's specified and implied requirements, industrial codes and national standards and shall be produced and delivered to the customers on schedule.

We have been dedicated to supply the best quality products and services for our customers. And we have developed our own quality assurance program to comply with the ISO 9001 as required by the most authoritative International Organization for Standardization (ISO) in order to assure that Hyundai products are designed, manufactured, inspected, tested and delivered in the most efficient manner.

Hyundai Electric also considers human safety and environmental protection, the most important in performing all related works in its business, and thus acquired ISO 14001 (Environmental Management Certificate) and OHSAS 18001 Certificate (Occupational Health & Safety Management System Certificate) from DNV.

Worldwide Experiences

Hyundai transformers have been supplied to most of the countries all over the world and have achieved a world-wide reputation for their quality and performance to the customer's satisfaction.

EUROPE

300 kV 60 MVA Transformer
Nedre Vinstra Project in Norway

AFRICA

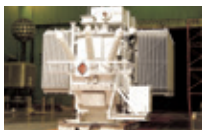
220 kV 125 MVA Transformer
Egyptian Electricity Transmission Company in Egypt

THE MIDDLE EAST

380 kV 502 MVA Transformer
Princess Nora Univ. Project in Saudi Arabia

ASIA

235 kV 500 MVA Generator Step-up Transformer
Bowin Combined Cycle Power Plant in Thailand



66 kV 20 MVA Transformer
Tokyo Electric Power Company in Japan

765 kV 204 MVA Generator Step-up Transformer
Dangjin Thermal Power Plant in Korea

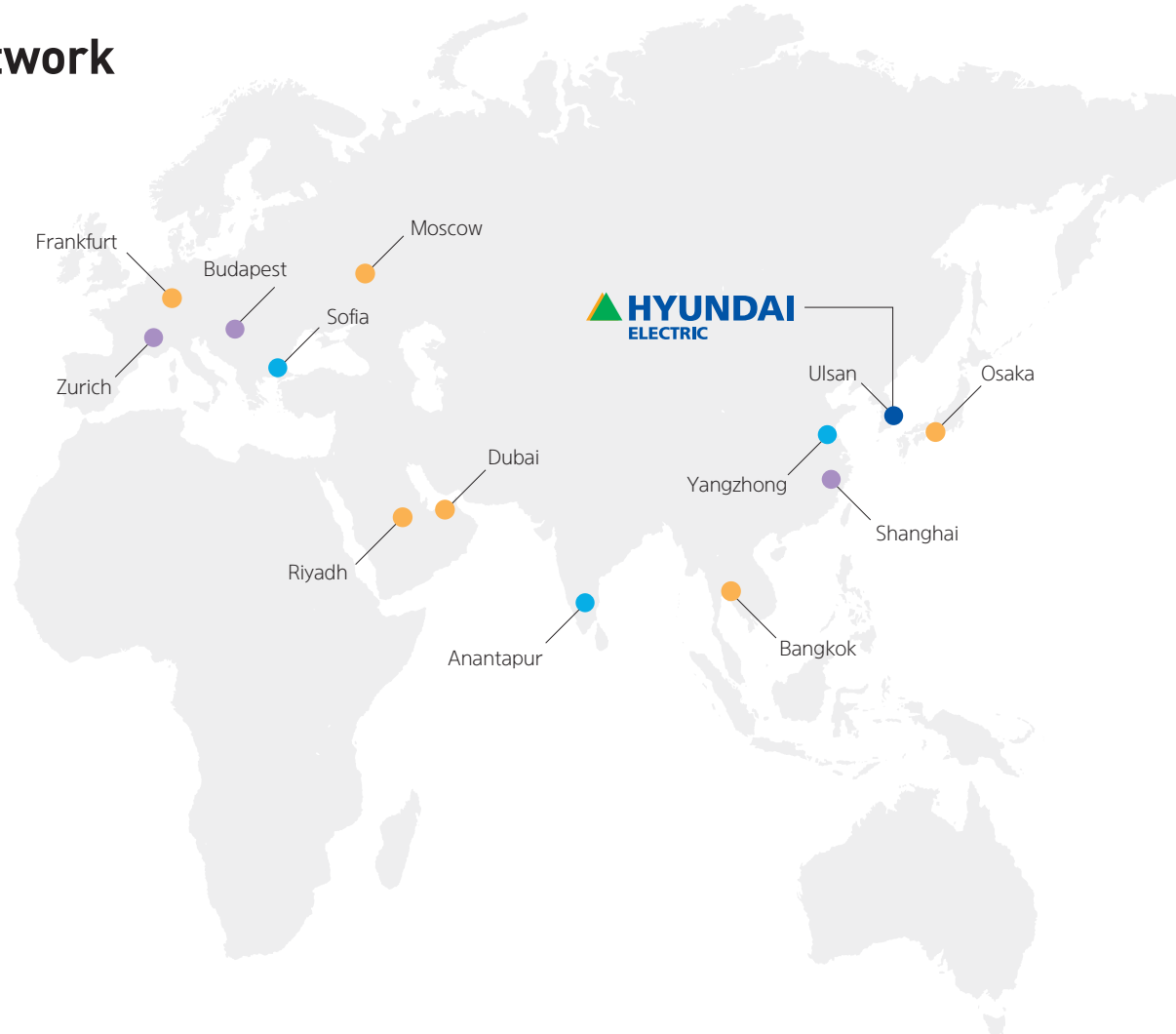
NORTH AMERICA

500 kV 750 MVA TPRS (Tank Pressure Relief System) Transformer / Hydro One in Canada

500 kV 390 MVA Generator Step-up Transformer
Tenaska Georgia Power Plant in USA

235 kV 205 MVA Generator Step-up Transformer
Sempra Energy in USA

Global Network



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KENYA
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NIGERIA
SOUTH AFRICA
SUDAN

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IRAQ
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LEBANON
OMAN
SAUDI ARABIA
SYRIA
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ASIA

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USA

CENTRAL AMERICA

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TRINIDAD AND TOBAGO

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HYUNDAI ELECTRIC

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OVERSEAS

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