creativity inspired HYOSUNG

Hyosung China
Nantong Transformer
for your power project

Hyosung China

50 YEARS
HYOSUNG

Global Business Premises

Hyosung is building a localized strategic global network With nearly 20,000 people working at 100 business sites in the world, and this has been the growth engine that has allowed Hyosung to become a global company where 70% of its profit are made from overseas businesses.

Overseas

32	21	10	16	16
Manufacturing Entities	Trading Entities	Trading Entities Branches	Trading Offices	Sales Offices

Domestic

14	5
Plants	R&D Centers

Nantong (China)

Nantong Hyosung Transformer Co., Ltd.

Changwon (Korea)

Hyosung Heavy Industry

Dong Nai (Vietnam)

Hyosung Dong Nai Co., Ltd.

Pune (India)

Hyosung T&D India Pvt. Ltd.

Sejong (Korea)

Hyosung Heavy Industry

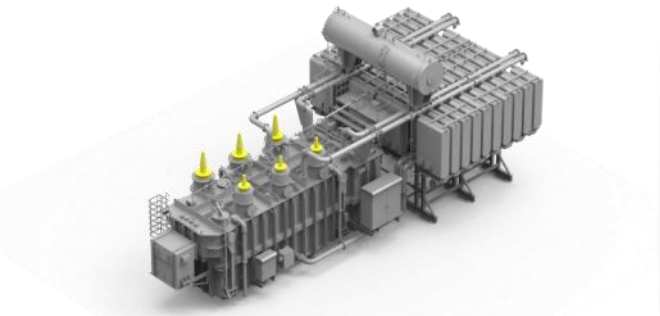
Memphis(U.S.A)

Hyosung HICO Ltd Memphis.

Transformer Product Line-up

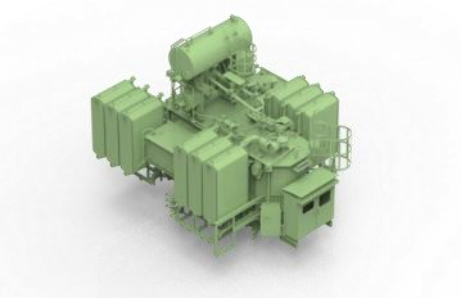
As the first domestic manufacturer of 765kV power transformers, Hyosung has earned a reputation of having the highest quality for over 40 years. Our transformers have off-load or on-load tap changers to adapt to various network conditions and satisfy both national and international standards. We make sure that the overall quality of design, manufacturing and testing of our power transformers meet the specific specifications of each country and we offer customized services to ensure customer satisfaction.

Extensive supply record in both core form and shell form technology. According to IEC, IEEE/ANSI, JEC, BS and all applicable national standards. Type/ Rating as below



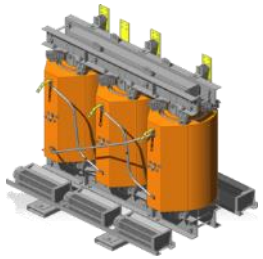
Power Transformers

- Up to 765kV, 1500MVA
- Core form/ Shell form
- Liquid-filled/ Gas-filled



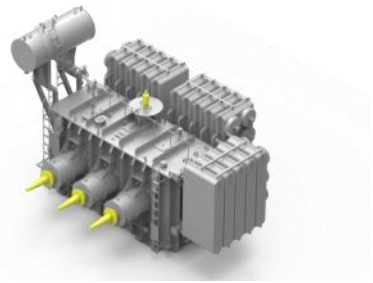
Oil-immersed Distribution Transformers

- Up to 77kV, 80MVA
- Core form type



Cast Resin Transformers

- Up to 33kV, 30MVA
- Core form type



Shunt Reactors

- Up to 765kV, 250MVAr
- Liquid-filled
- With or without OLTC

Various Applications

UHV (765kV) Transmission

Generation (GSU)

- Converter TRs
- Rectifier TRs

Mining, Steel Furnance TRs

Mobile TR

Transportation
- Scott TRs
- Rail TRs

FACTs System

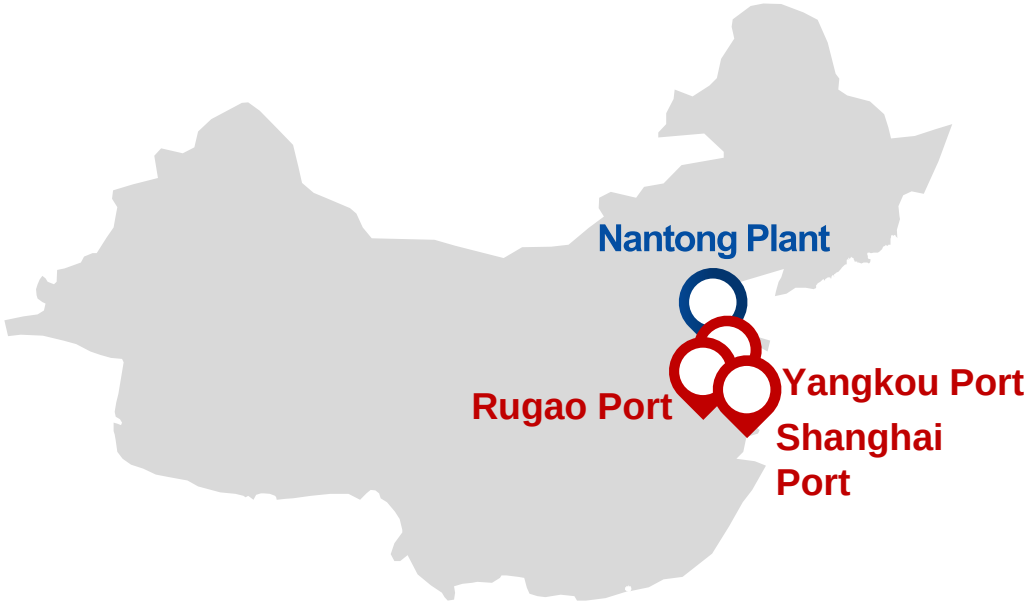
Nantong Plant Overview

- **No. of employees : 600**
- **Area 200,000 m²**
- **Production Capacity : 40,000MVA/year**
- **Products**
  - Power transformers
  - Distribution transformers, incl. oil-immersed type and cast-resin type
  - Special transformers for industry application (Rectifier Transformers)

Location

- **Hai'an Development Zone, Jiangsu China**

to Rugao Port	80 km
to Yangkou Port	82 km
to Shanghai Port	250 km



Same Plant At Two Locations

Personnel

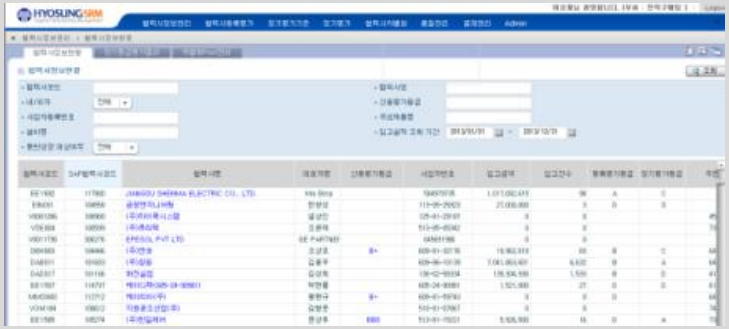
- 30% experienced former Changwon factory managers, Nantong factory has a large number of skilled design engineers
- The GM and VP are always experts from Seoul/Changwon
- Professional design, production and procurement managers were transferred to the Nantong plant

Standard

- Quality and production standards & processes are managed by Changwon quality management team

System

- Both plants share the same SAP system and vendor management system

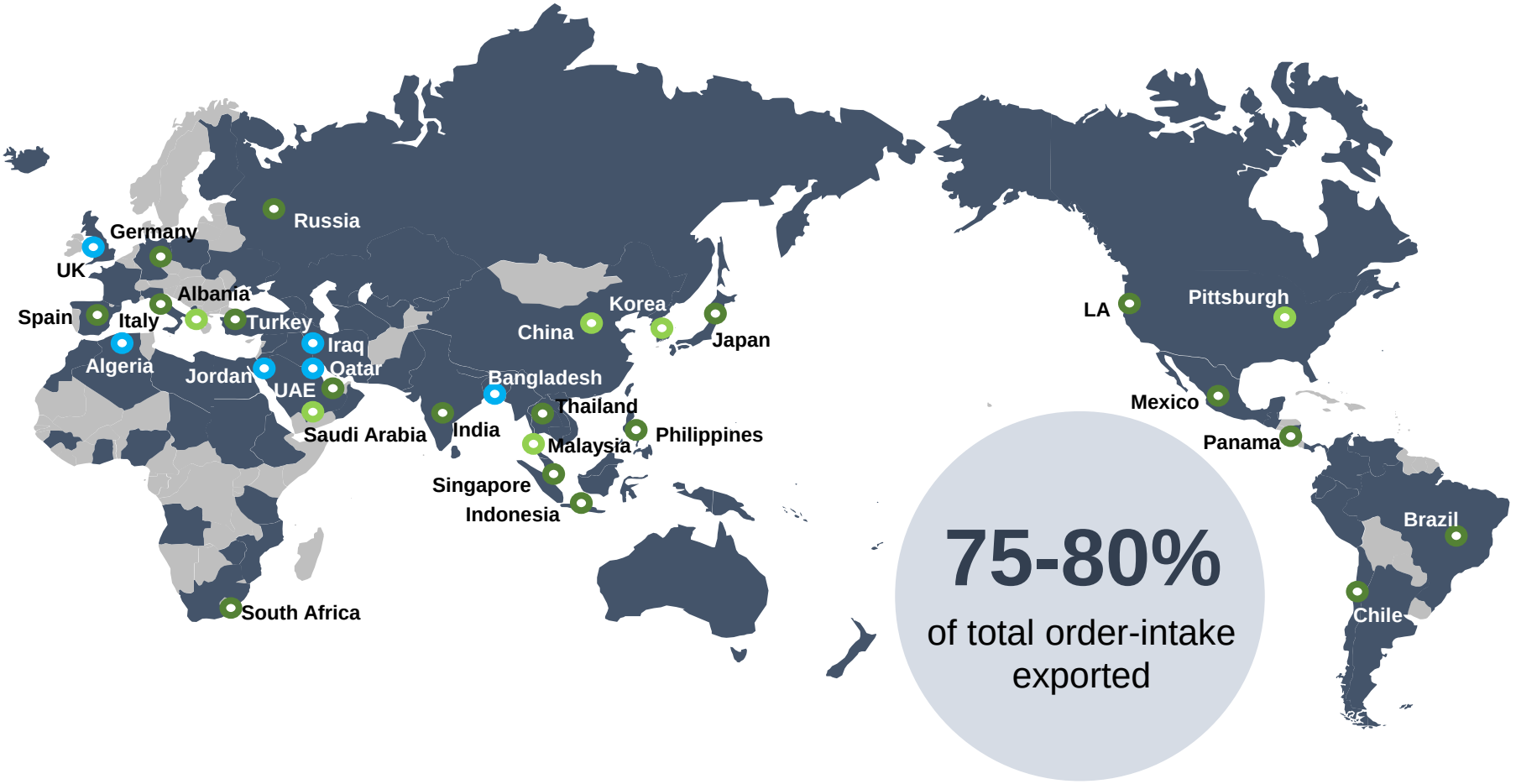


Technology

- Same design specifications and manuals.
- Same design software.
- Share technology and applications weekly Frequent exchange training from Same technology center in Changwon

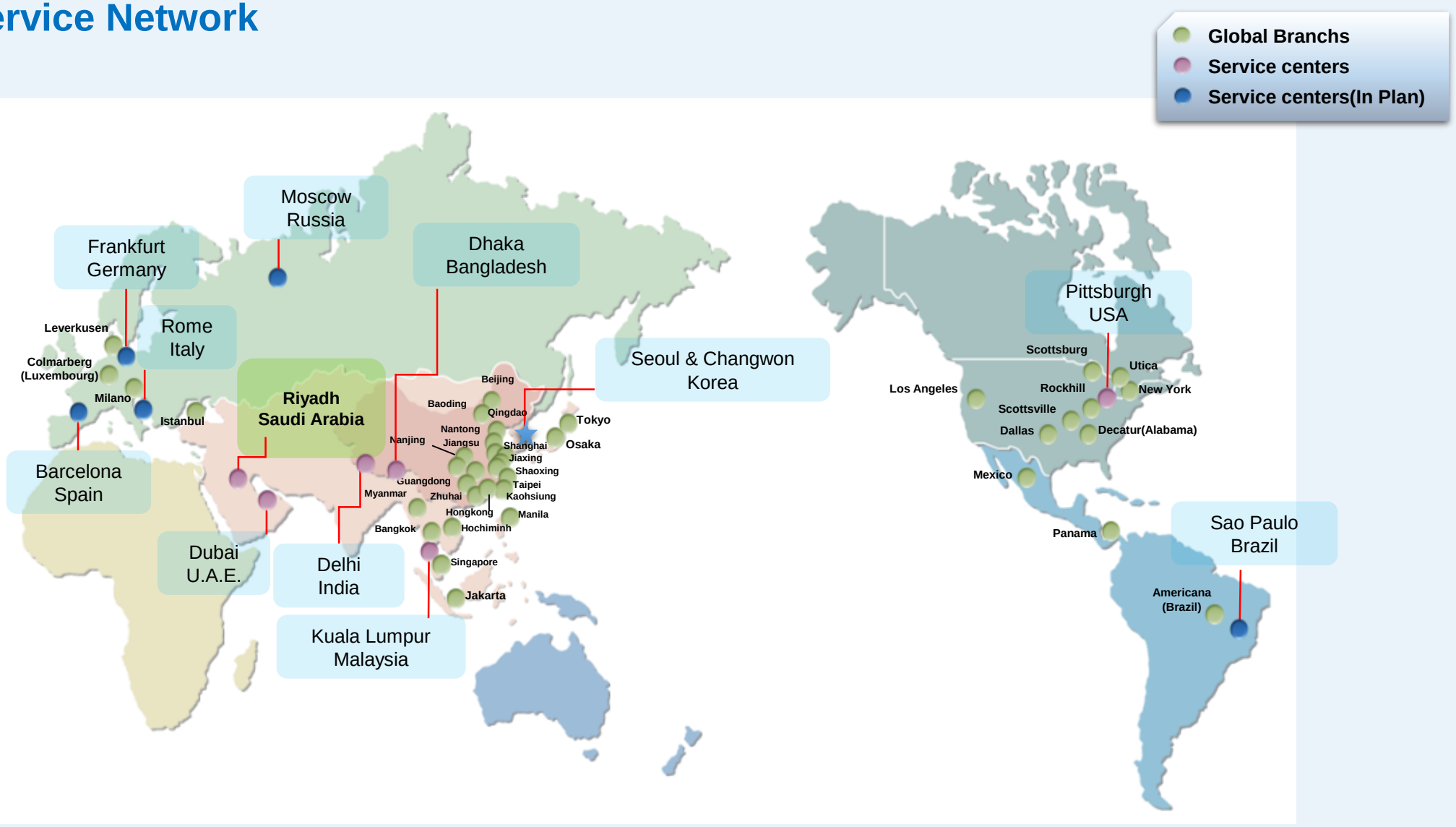
Global Business Coverage

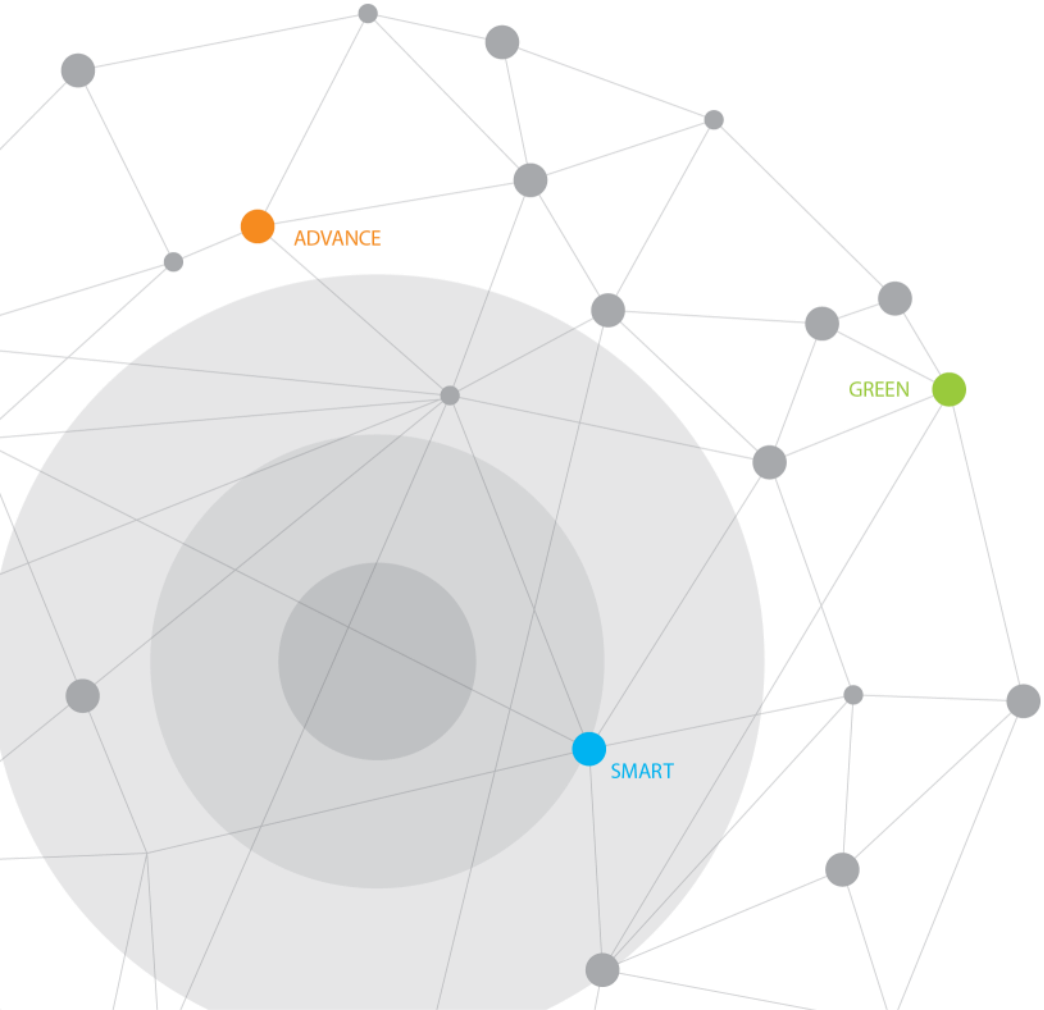
Hyosung has supplied power transformers to more than 70 countries and continues to serv e the global market. Hyosung's overseas sales account for more than three-quarters of its t otal sales.



Global Business Coverage

Service Network





III

Hyosung's Strength

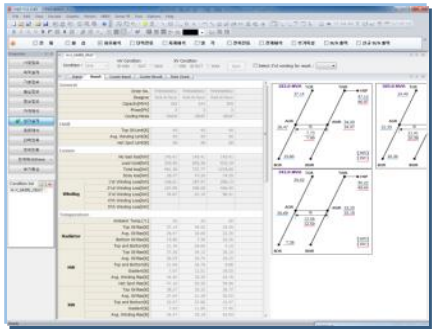
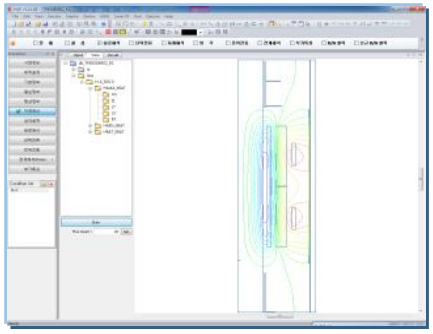
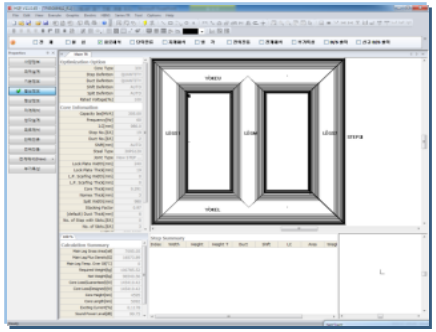
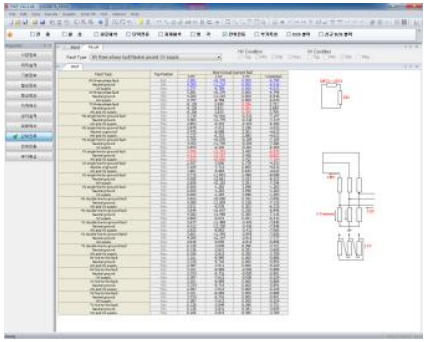
01 Design Capability
02 Robust Tank Construction
03 Superior Short-Circuit Reliability
04 Sophisticated Customization
05 Thorough Quality Management
06 Modern Manufacturing/Testing System
07 Excellent Service
08 Fast And Flexible

50 YEARS
HYOSUNG

Designing Software Developed Independently

- Since 1962, for about 57 years, Hyosung has been committed to continuously analyzing the gap between th e design value and the actual value, and has independently developed a set of design software with high reli ability and stability.
- Adoption of advanced 3D automatic drawing system which can effectively avoid human error and shorten the design time ,make it possible to provide the transformers in short-term lead time.

■ Basic design modules (load, no load, temperature ris e, impedance, short circuit, mechanical strength, etc.)

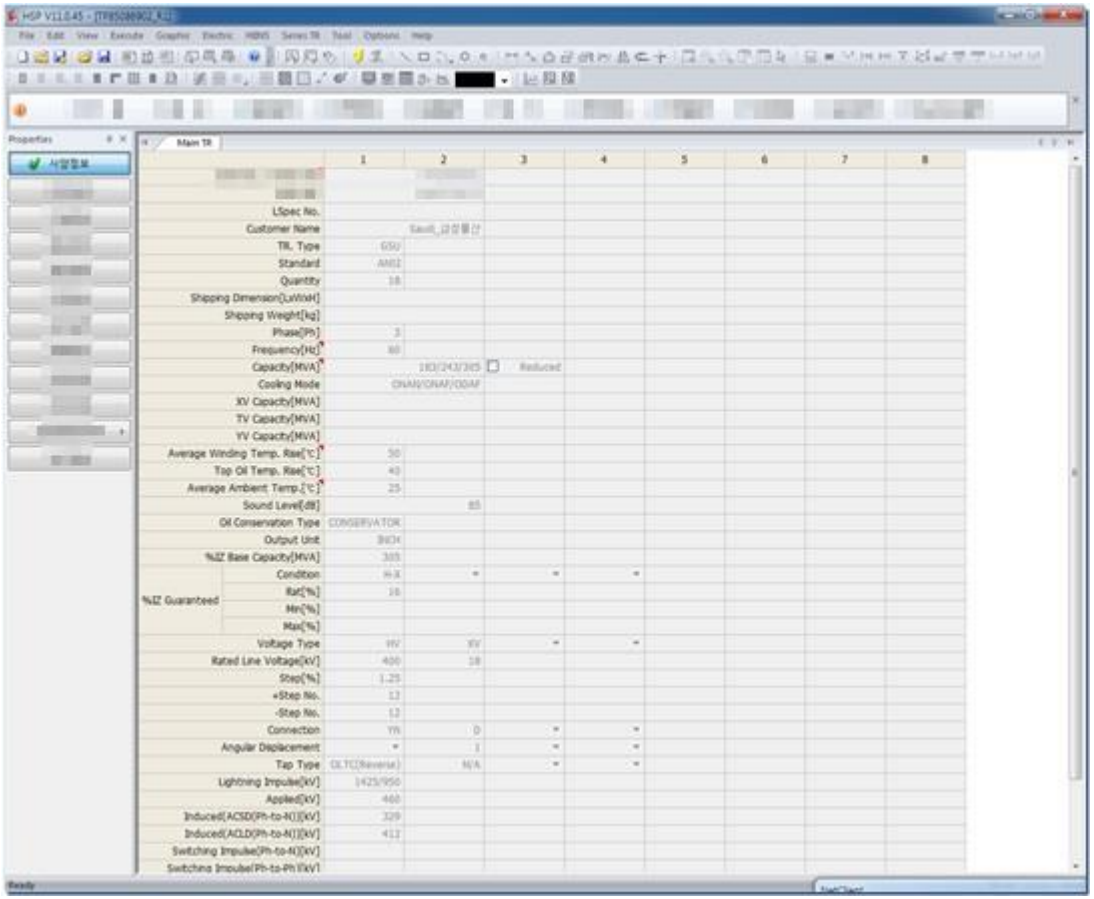





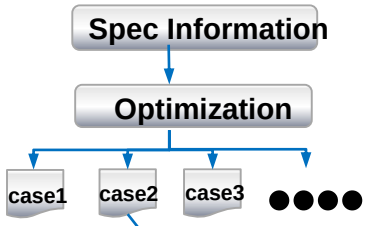
■ Automatic drawing module (core, winding, clip an d support, lead, fuel tank structure)

HSP (Hyosung Power Transformer Program)

– Integrated Design Software Used Throughout Quotation, Basic and Detailed Design Stage

Integrated 12 design modules , calculate
6 major characteristics





Customer Spec Input Module

Optimization Design Module

Basic Design Module

Core Design Module

Winding Layout Design Module

%IZ, Force, Loss Calculation Module

Cooling Design Module

Circulating Current Calculation Module

Short Circuit Current Calculation Module

Transient Voltage Analysis Module

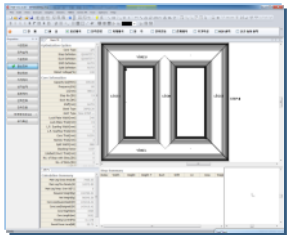
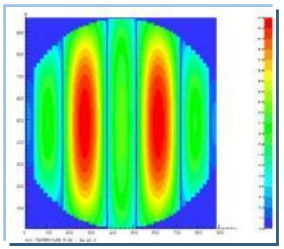
Additional Characteristics Module

Design Sheet Output Module

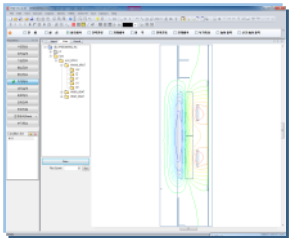
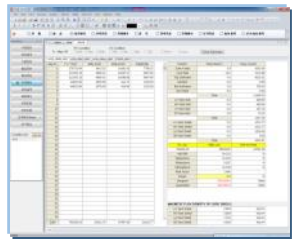
01 Design Capability

HSP – The main modules

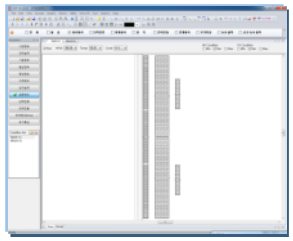
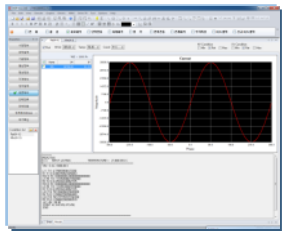
Core design - core dissipation and temperature analysis

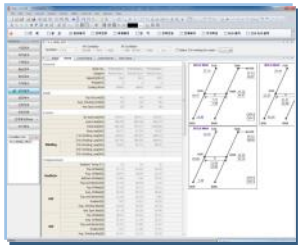
Magnetic analysis - % Iz, dissipation and temper-ture analysis

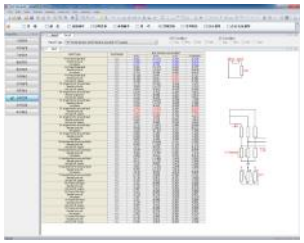
Circuit Analysis - %IZ & Circulation Calculation

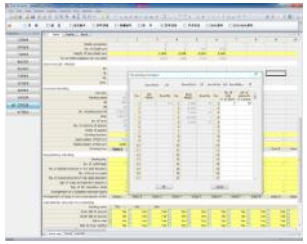
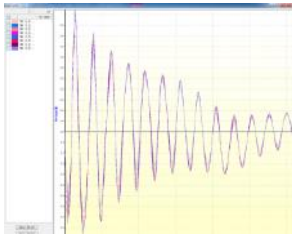
Cooling and winding temperature analysis



Short circuit - short circuit current calculation



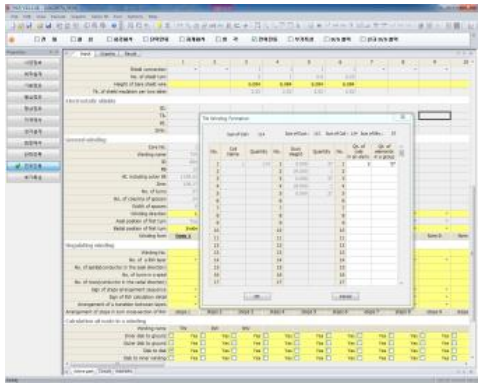
Transient analysis - transient voltage analysis

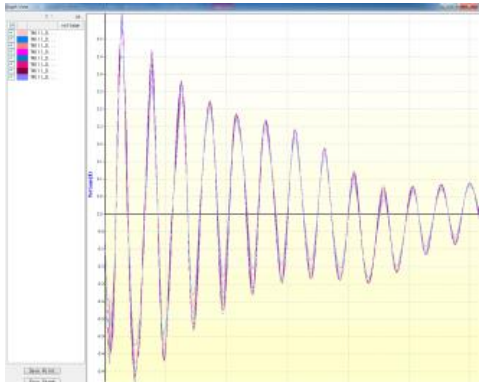



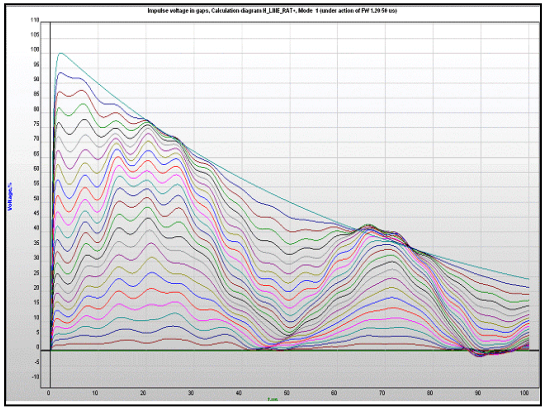
Superior Insulation Design Verification Program

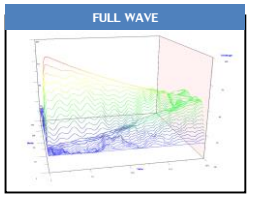
■ Transient voltage analysis program module

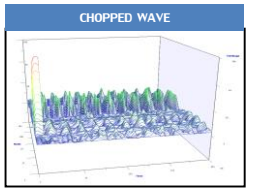
- Accurately calculate the voltage distribution of transformer windings under any overvoltage condition.
- Prove the high reliability of this module in years of practical measurements.





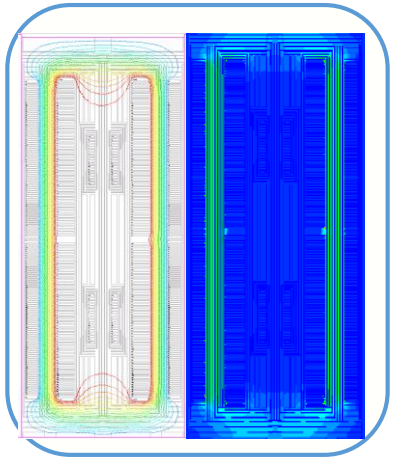


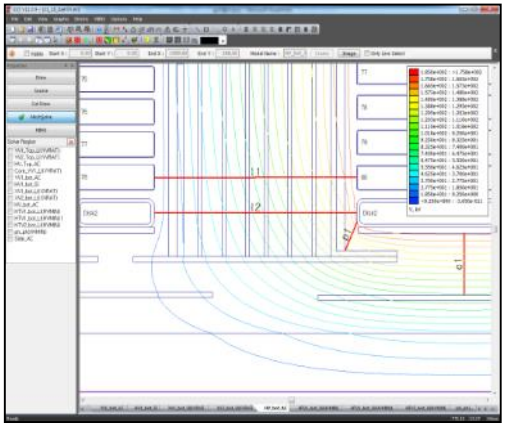


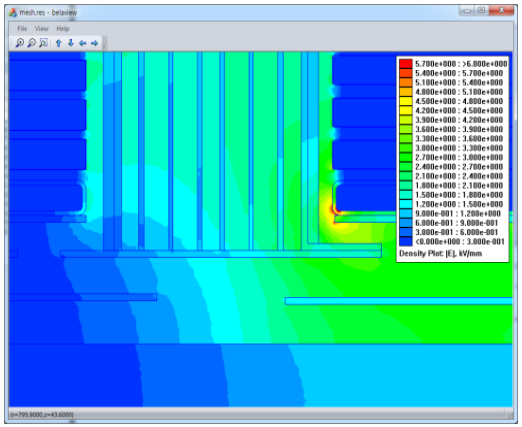


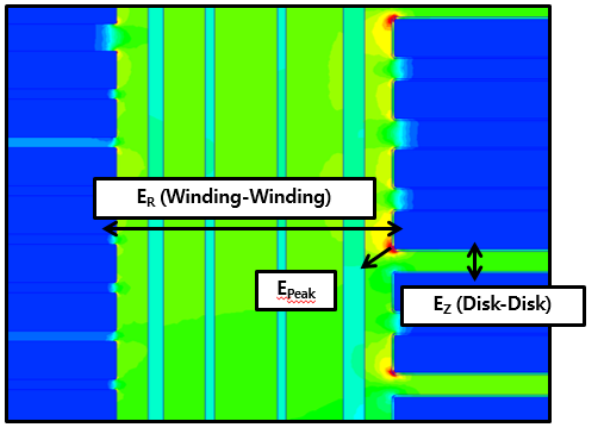
■ Electric field analysis

- Optimized automatic insulation analysis (ER, EZ, EPEAK) for all transformer bodies, considering the most extreme conditions. This helps to improve the reliability of insulation design and prevent insulation failure





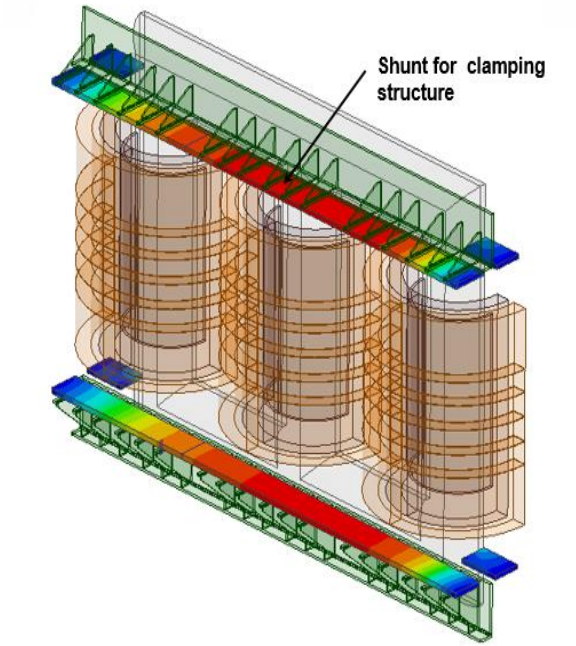




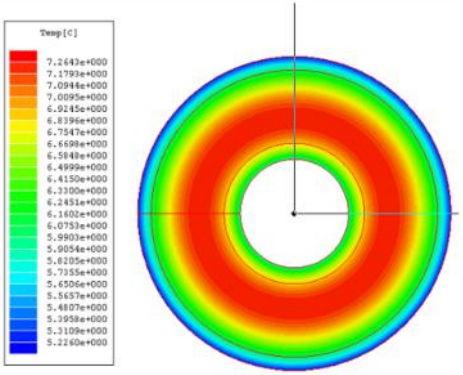
Long-term anti-aging effect design

- Design should be considered to avoid the aging effect caused by local overheating and high temperature rise, which leads to the problem of transformer life shortening
- Especially high impedance (high MFL) transformers need to be controlled by magnetic shielding or reactor
- In FAT process, use thermal imager to check the external temperature to determine whether there is overheating

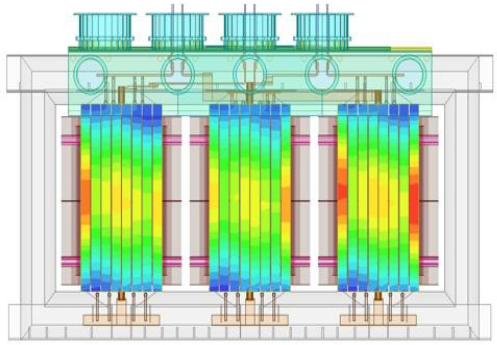
Magnetic shielding for yoke clamp



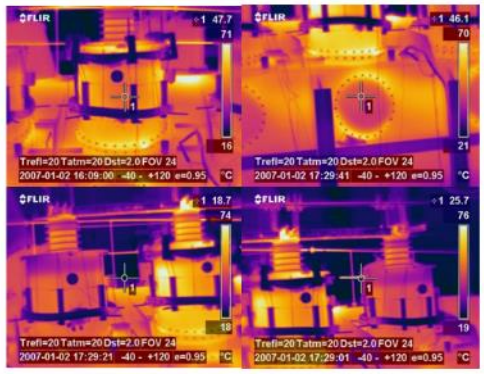
Shunt reactor Bundle Temperature



Magnetic shielding for tank wall

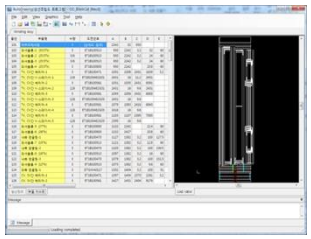
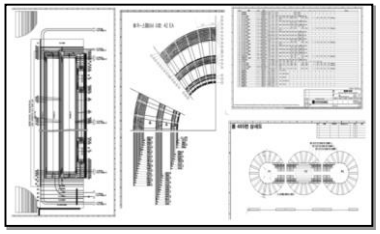
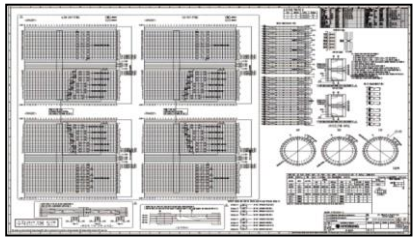


Thermo camera check during FAT

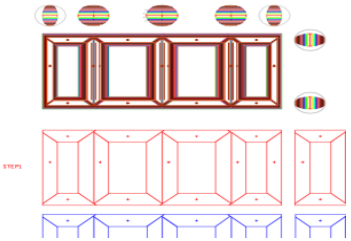


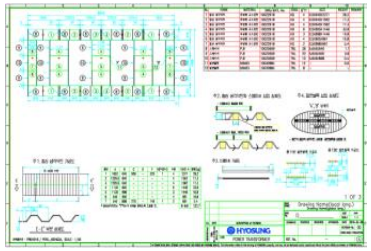
01 Design Capability

- Automatic drawing - winding and assembly (including insulation) design and automatic drawing program

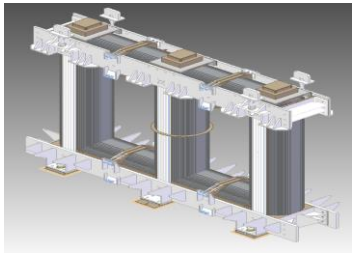




- Automatic core and end frame design - automatic core design and automatic drawing program

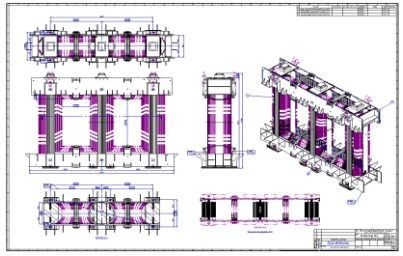




Automatic cooling of ducts and grooves drawings

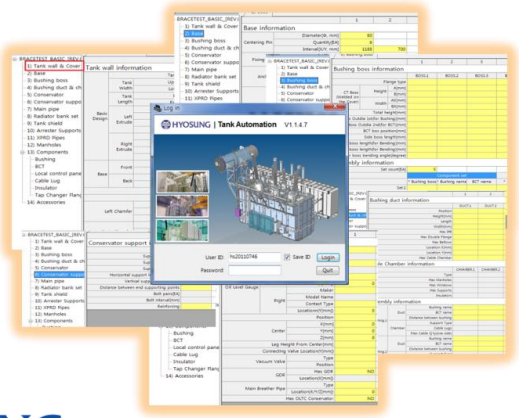


Automatic 3D design of transformer end frame

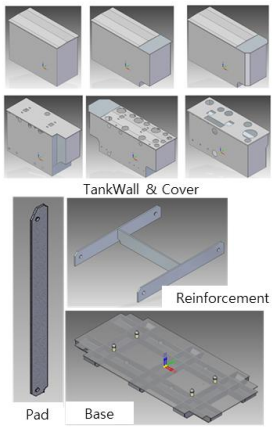


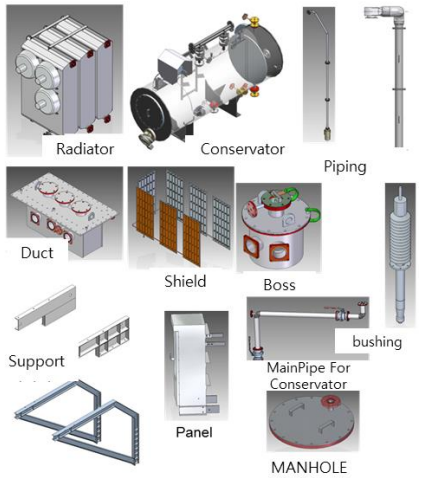
Automatic drawing assembly of end frame

Input Parameters



Make component drawings



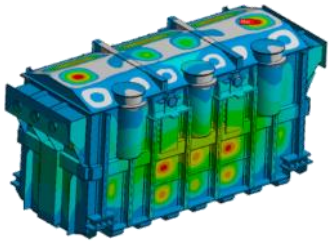


02 Robust Tank Construction

Transformer Tank Is Designed To Withstand Various Stresses Of Vacuum, Lifting, and Jacking Events

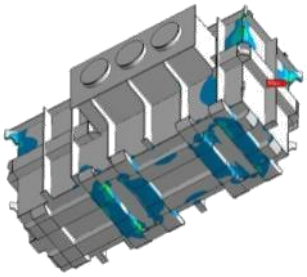
Vacuum

Stress

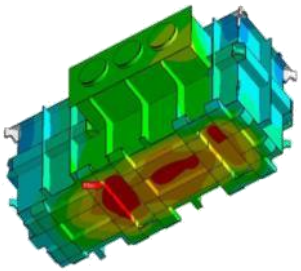


Displacement

Lifting

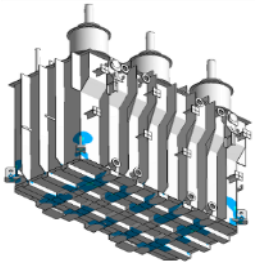


Stress

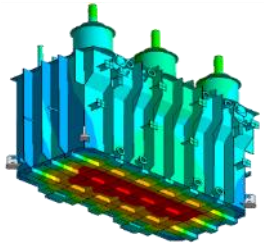


Displacement

Jacking



Stress

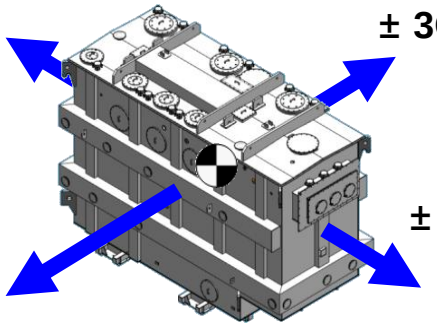


Displacement

02 Robust Tank Construction

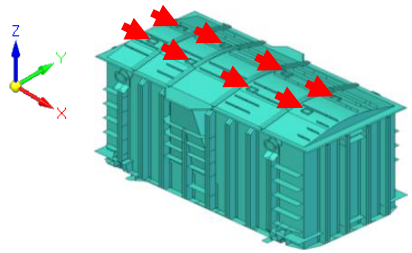
Analysis For Safe Transportation

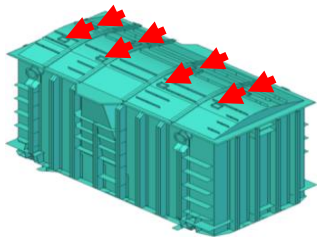
- Hyosung's power transformers are designed to withstand minimum 3G shipping acceleration for transverse and longitude directions.
- Hyosung has Extensive Experience In Various Transportation Modes(Truck, Rail, Ship, Airplane).

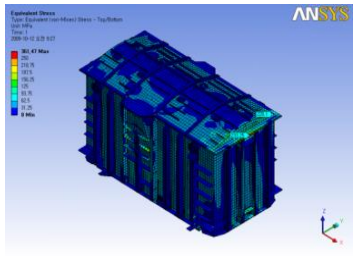


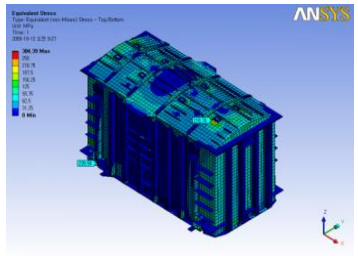
± 3G (Transverse direction)

± 3G (Longitude direction)







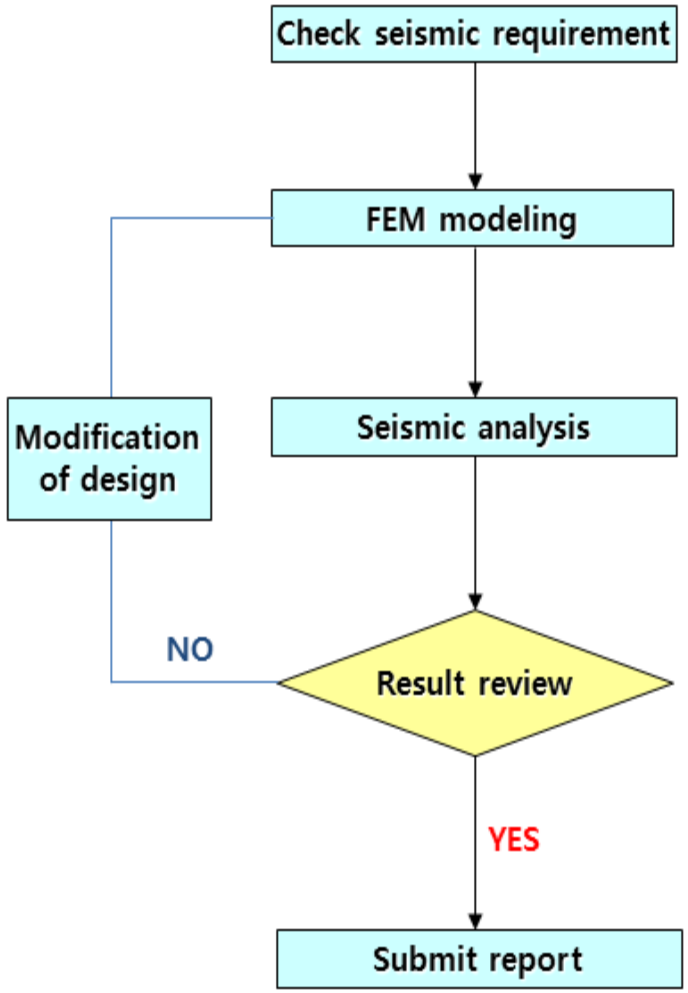


- Transported by truck Shipping acceleration : 5.0G
- Transported via airplane Shipping acceleration : 3.5G

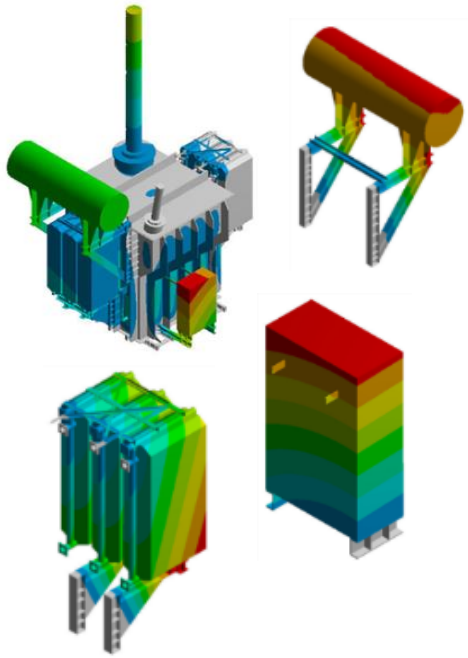
02 Robust Tank Construction

Seismic Design and Analysis

Seismic design process



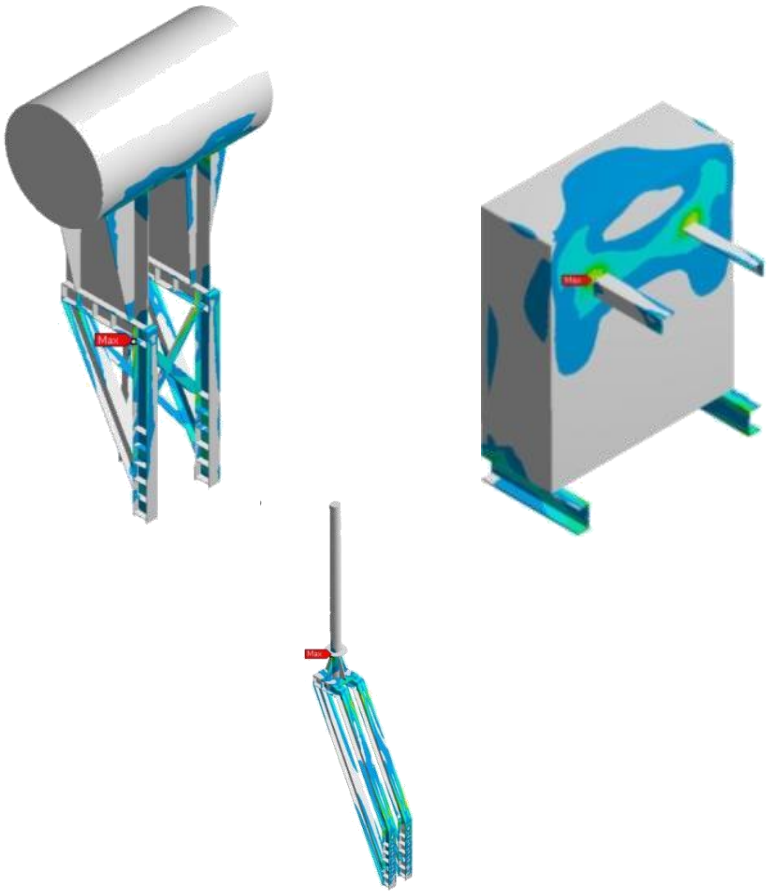
- ✓ **Seismic design criteria**
  - Earthquake Zone
  - Seismic Zone Factor
  - Seismic Acceleration



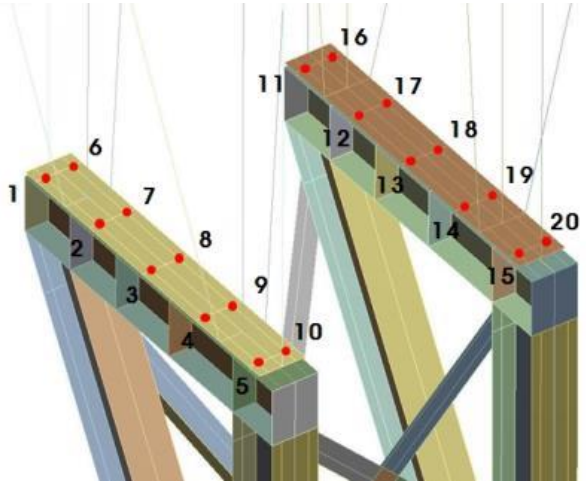
Hyosung's Major Experiences in Seismic Standards

IBC
IEEE
UNIFORM BUILDING CODE™
NRC·CNRC Institute for Research in Construction
STANDARDS Australia
INPRES
BSI British Standards
STANDARDS NEW ZEALAND PAEREWA AOTEAROA
भारतीय मानक ब्यूरो
मानकः पथप्रदर्शकिः
BUREAU OF INDIAN STANDARDS

Structural pressure analysis and evaluation of seismic conditions



Seismic analysis and evaluation of all connection points



Input node force

AISC-J3 Bolt 강도평가 계산시트

input data
calculated value

AISC-J3 (ASD)

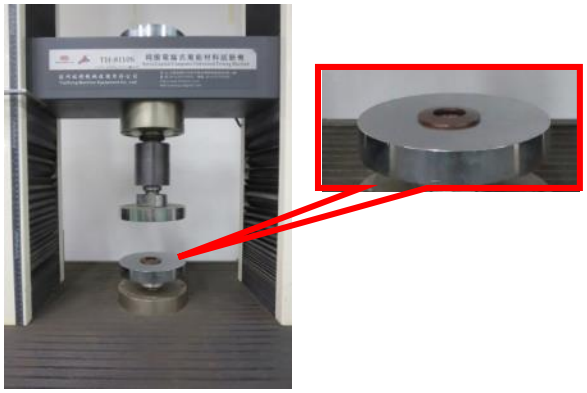
1. Input data	Value	unit
	830.00	MPa
	M24	-
	2	-
	16775	N
	31900	N
	1143.7	N
	Fz	-
2. Calculation variable		
	622.5000	MPa
	332.0000	MPa
	94.3960	MPa
	455.2652	MPa
	173881.2168	N
3. Check variable		
	fv ≤ Fnv/Ω	OK!
	Rn/Ω > Fz	OK!

Mechanical Test For Raw Materials

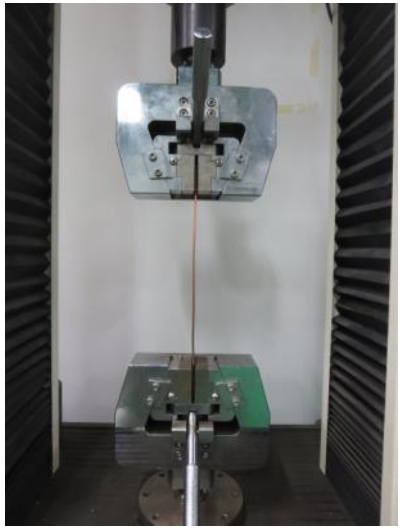
Hyosung manages mechanical properties of raw materials through compression, bending and tension tests

Universal Testing Machine

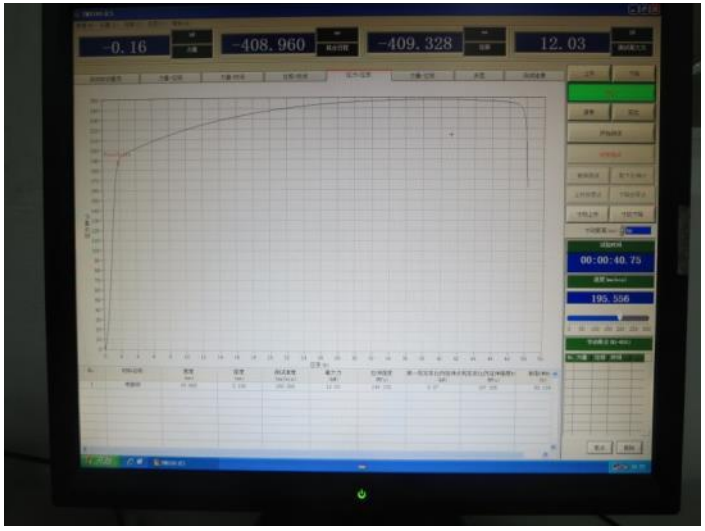
Bending Test



Compress Test



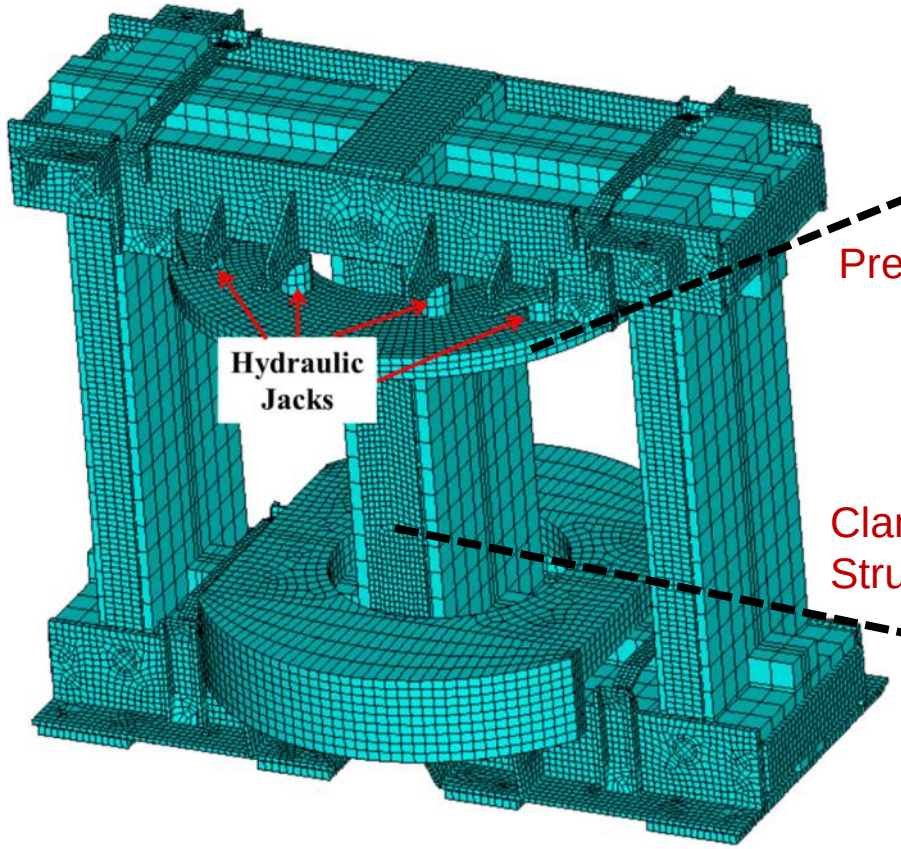
Tension Test



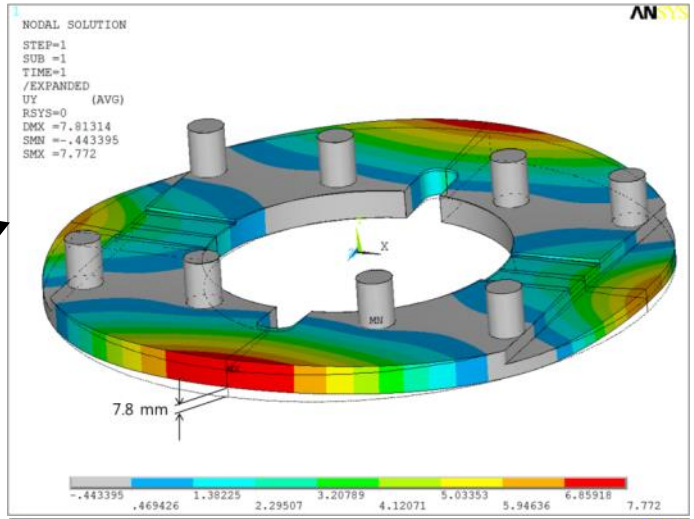
Test Result

Detailed Clamping Structure Evaluation For All Short-circuit Modes

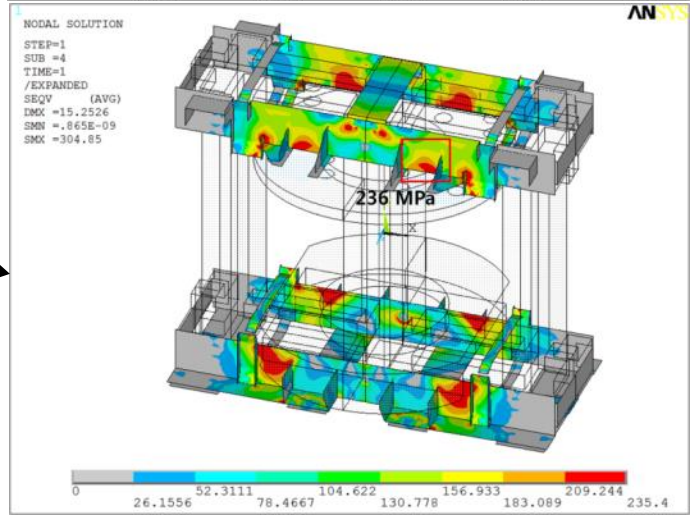
Adding to Hyosung's accurate calculation of short-circuit events , Hyosung utilizes FEM(ANSYS) analysis for stresses on clamping structures, under final clamping, lifting load and short-circuit events, for thorough evaluation.



Pressure-Ring

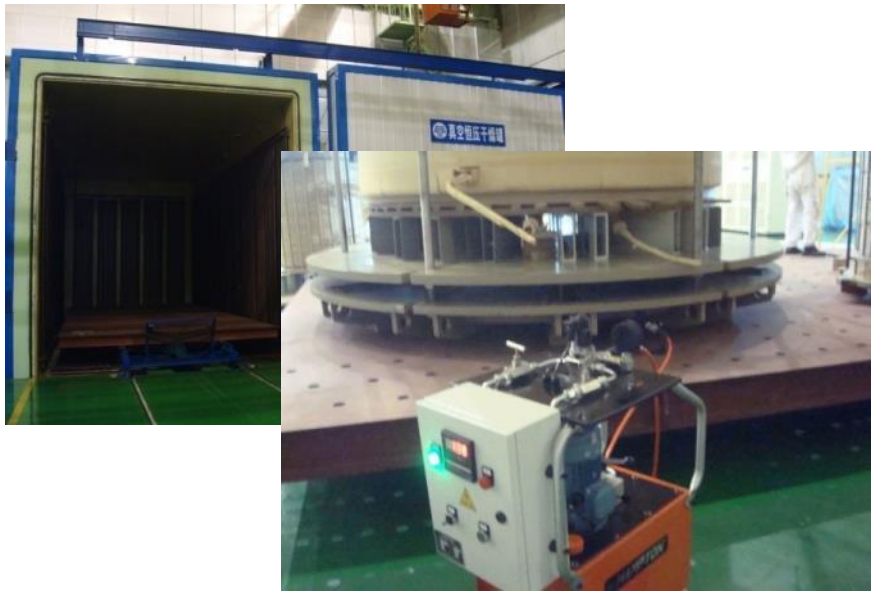


Clamping-
Structure



03 Superior Short-Circuit Reliability

Advanced Manufacturing Process Control



Winding Stabilization Process

- Vaporphase drying under constant pressure
- After drying, a few additional sizing loads for stabilized winding height are applied

Final Clamping Process

- Using hydraulic jacks and inserting pressing wooden block for constant clamping of winding

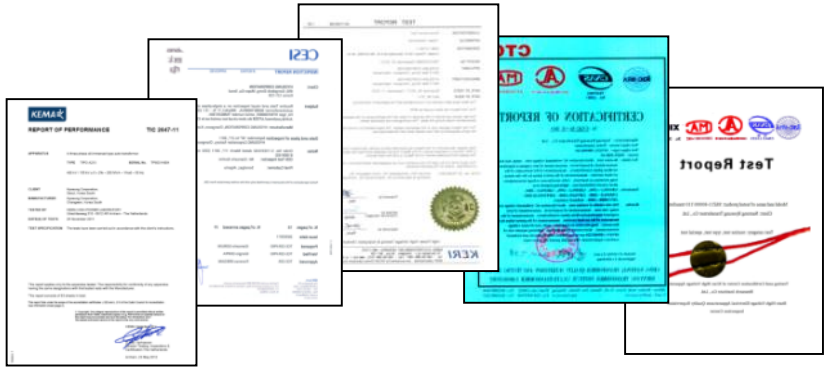
▲ core & coil pressing system by max. 8 hydraulic jacks

Abundant Records Of Actual Short-circuit Tests For High Reliability

End User	Description	Test Lab.	Date
KEPCO	3ph 60Hz 60MVA 154/23kV YYD (FOW)	KERI	'96.08.06
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (ONAF)	KERI	'97.04.17
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (FOW)	KERI	'98.12.17
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (Gas-Insulated)	KERI	'00.01.18
KEPCO	3ph 60Hz 60MVA 154/23kV YYD (Less-Flammable)	KERI	'01.02.15
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (ONAF)	KERI	'06.11.30
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (Gas-Insulated)	KERI	'07.06.07
KEPCO	1ph 60Hz 20MVA 154/23kV YYD (Low-Sound)	KERI	'08.08.20
SGCC	3ph 50Hz 80MVA 110/21/10.5kV YYD	XIHARI	'09.08.18
SGCC	3ph 50Hz 50MVA 110/10.5kV YD	CTQC	'09.12.01
KEPCO	3ph 60Hz 60MVA 154/23kV YYD (ORDF)	KERI	'09.12.10
SGCC	3ph 50Hz 180MVA 230/121/11kV YYD	CTQC	'10.07.28
GASCO	3ph 50Hz 50MVA 132/11kV YD	KERI	'10.11.30
GASCO	3ph 50Hz 120MVA 132/34.5kV YYD	KERI	'10.12.01
SONELGAZ	1ph 50Hz 100MVA 400/225kV AUTO	CESI	'11.06.24
TERNA	3ph 50Hz 250MVA 400/115kV AUTO	KEMA	'11.11.25
JRTR	3ph 50Hz 6MVA 34.7/4.16kV YD	KERI	'12.03.17
IESCO	3ph 50Hz 40MVA 132/11.5kV DY	CTQC	'12.12.07
GEPCO	3ph 60Hz 26MVA 132/11.5kV DY	KERI	'13.01.30
SGCC	3ph 50Hz 63MVA 110/38.5/10.5kV YYD	CTQC	'13.12.30
KEPCO	1ph 60Hz 20MVA 154/23kV YYD	KERI	'14.06.29
SONELGAZ	1ph 50Hz 100MVA 400/225kV AUTO	KEMA	'14.12.16
KEPCO	3ph 50Hz 2.209MVA 22/0.096kV DD	KERI	'15.03.09
KEPCO	3ph 50Hz 0.6485MVA 22/0.096kV DD	KERI	'15.03.09
SGCC	3ph 50Hz 180MVA 220/115/10.5kV AUTO	CTQC	'16.04.13
SGCC	3ph 50Hz 50MVA 110/10.5kV YD	CTQC	'18.08.15
EETC	1ph 50Hz 1ph 50Hz 250MVA 500/242/24kV	ASTA	'19.03.04
SGCC	3ph 50Hz 63MVA 110/38.5/10.5kV YYD	CTQC	'19.03.20
SGCC	3ph 50Hz 240MVA 220/115/10.5kV AUTO	CTQC	'19.06.26

Short-Circuit Test Records for the past 25 years

* CESI — Centro Elettrotecnico Sperimentale Italiano
* CTQC — China National Transformer Quality Supervision and Testing Center
* GASCO — Abu Dhabi Gas Industries Ltd.
* GEPCO — Gujrawala Electric Power Company in Pakistan
* IESCO — Islamabad Electric Supply Company in Pakistan
* JRTR — Jordan Research & Training Reactor
* KEMA — Netherland Association for Testing Electrical Materials
* KEPCO — Korea Electric Power Corporation
* KERI — Korea Electrotechnology Research Institute
* SGCC — State Grid Corporation of China
* SONELGAZ — Electric Power Company in Algeria
* TERNA — Italian Electricity Transmission System Operator
* XIHARI — Xian High Voltage Apparatus Research Institute



04 Thorough Quality Management

Quality Management Certified by International Quality Certification

ISO 9001

- Quality Management System based on ISO9001:2008
- Approved by CQC

ISO 14001

- Environmental Management System based on ISO14001:2004
- Approved by CQC

OHSAS 18001

- Health & Safety Management System based on OHSAS 18001:2007
- Approved by CQC

04 Thorough Quality Management

International quality certification quality management ISO 17025

China National Accreditation Service for Conformity Assessment

LABORATORY ACCREDITATION CERTIFICATE

(Registration No. CNAS L13170)

Laboratory of Nantong Hyosung Transformer Co., Ltd.

(Legal Entity: Nantong Hyosung Transformer Co., Ltd.)

No.88, Xiaoxing Road, Development Zone, Hai'an, Nantong, Jiangsu, China

is accredited in accordance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories(CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence to undertake the service described in the schedule attached to this certificate.

The scope of accreditation is detailed in the attached schedule bearing the same registration number as above. The schedule forms an integral part of this certificate.

Effective Date：2020-03-05

Expiry Date：2026-03-04

Signed on behalf of China National Accreditation Service for Conformity Assessment

China National Accreditation Service for Conformity Assessment (CNAS) is authorized by Certification and Accreditation Administration of the People's Republic of China (CNCA) to operate the national accreditation schemes for conformity assessment. CNAS is a signatory of the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA) and the Asia Pacific Accreditation Cooperation Mutual Recognition Arrangement (APAC MRA).

The validity of the certificate can be checked on CNAS website at http://www.cnas.org.cn/english/findanaccreditedbody/index.shtml.

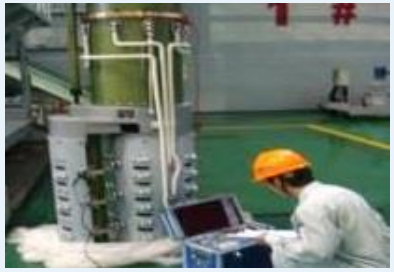
04 Thorough Quality Management

Material/Components Procurement

Effective Supplier Management

- Semi-annual supplier evaluation
- 3 strike-out for non-conforming material/component
- Approval after re-audit for new suppliers

▲ PRD test



▲ OLTC test

HYOSUNG SRM
Supplier Relationship Management

*Same system as Changwon plant

Global Suppliers for Materials & Parts

Core	POSCO, WISCO, 首钢集团 SHOUGANG GROUP
Steel Plate	POSCO, NISCO
Coil	YT, 统力电工 TOLY ELECTRIC
Bushing	ABB, TRENCH, HUBBELL, 南京智达电气有限公司 NANJING ZHIDA ELECTRIC CO.,LTD
Tap Changer	Reinhausen, MR, SMB, ABB, 贵州长征 CHANGZHENG
Insulation	WEIDMANN ELECTRICAL TECHNOLOGY, WEIDMANN, YZ
Oil	NYNAS, Shell, Sinopec, 中国石油
Relay	SEL, Reinhausen, MR, CEDASPE, QUALITROL Defining Reliability, EMB WITTLICH

04 Thorough Quality Management

Thorough Inspection Throughout Every Manufacturing Process

Receiving Materials and Components
↓
Receiving Inspection by QC
↓ *Accept*
Manufacturing
↓
Self-Inspection by Worker
↓
In-Process Inspection by QC
↓ *Accept*
Final Assembly
↓
Final Inspection & Test by QC
↓ *Accept*
Packing Inspection

- **In-process Inspection Point**
  - Hold Inspection Point
  - Patrol Inspection Point
- Notification for the designated H/W points by QC & customer
- Calibrated testing equipment & qualified inspector/tester
- Performing according to inspection & test procedure


Receiving Insp.


Self-Insp.


In-process Insp.


Final Insp.& Test


Packing Insp.


Inspector/Tester Cert.

- At any stage, nonconforming products are detected through by QC engineers who issue NCRs.
- If NCR is not closed, the product can not be proceeded to the next operation.

04 Thorough Quality Management

- Inspections are differentiated, X-ray machine to check insulation parts to ensure product life.
  Check raw materials and main components before warehousing indoors

Conductor resistance measurement

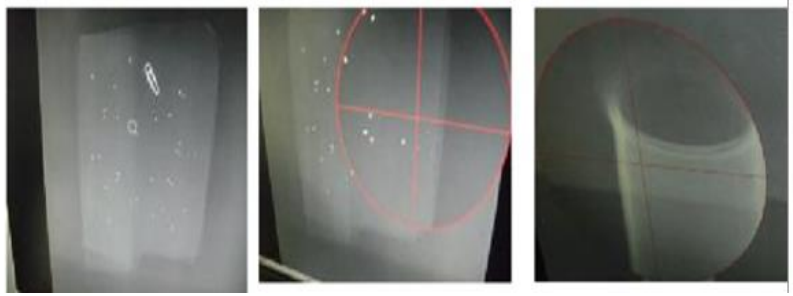
Gas relay inspection

PRD inspection

Temperature indicator inspection

Silicon plate inspection

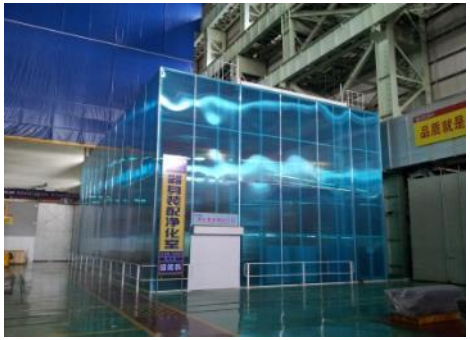
OLTC inspection



X-Lay Test

05 Modern Manufacturing/Testing System

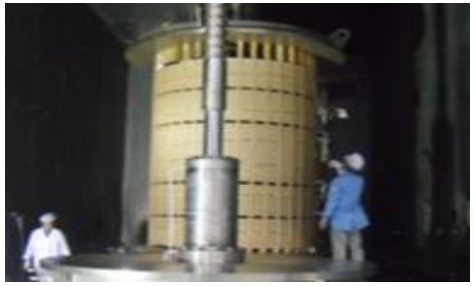
Clean Environment

Advanced air-conditioned ventilation
and purification system

High Standard for Precision

Computer-controlled processes



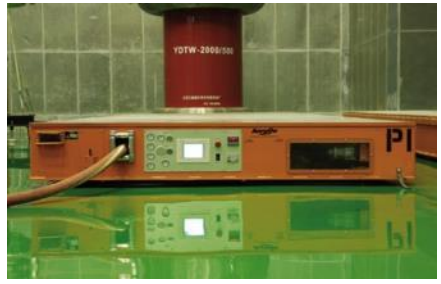
Strict dimension control
after drying

Modern Manufacturing Machinery

Vapor-phase drying plants

Vertical and horizontal
winding machines

Large sized cranes:
up to 400 tons



Air pallets:
up to 500 tons (250 tons*2)

05 Modern Manufacturing/Testing System

In-house UHV Testing Capacity

LI: ~4800kV BIL, SI: ~2800kV BSL

Large Testing Capacity

Test Lab

- 2,400 m^2 (25,834 ft^2)
- Up to 1,000kV

Receiving Insp./Test Lab

Oil Test Lab in house

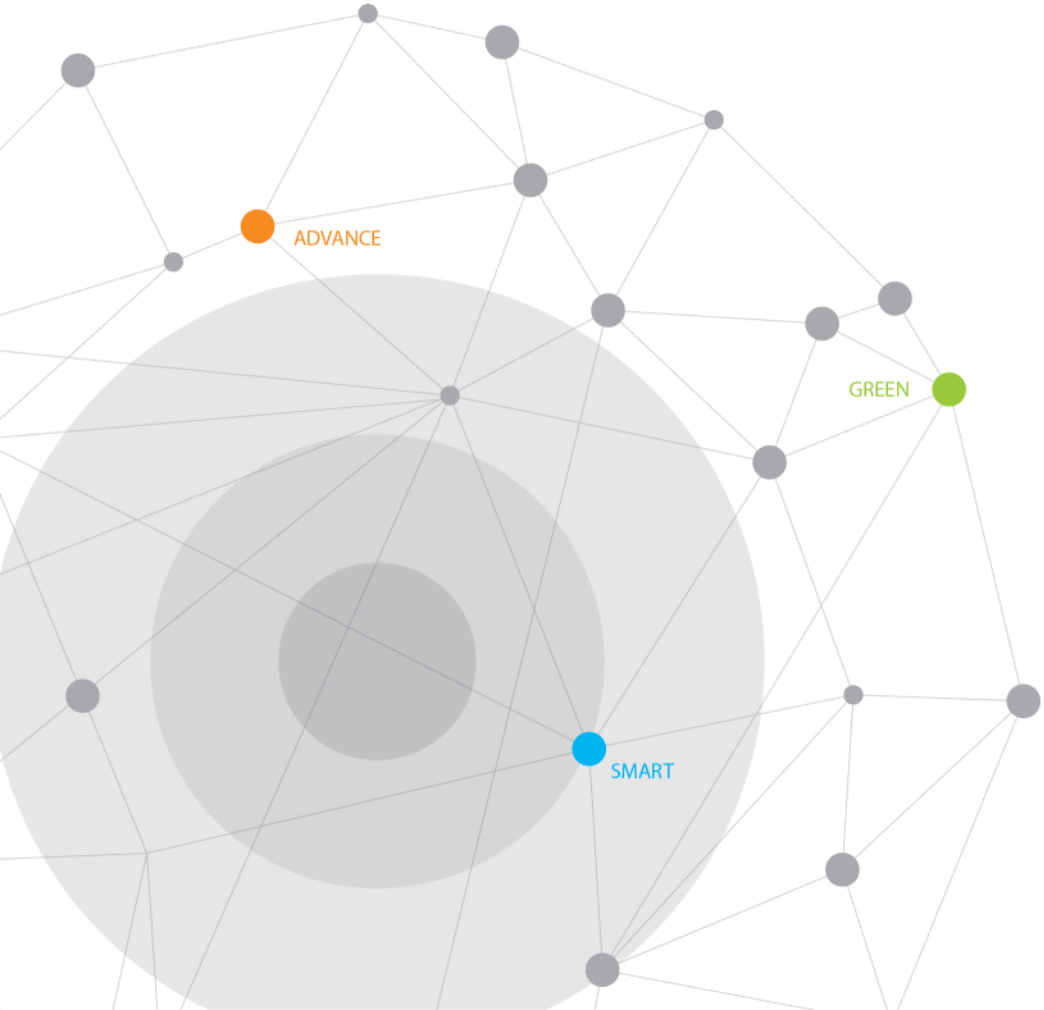
Modern Testing Facilities

Control room

Doble/USA

Haefely/Swiss

Highvolt/Germany



Ⅳ

Key Projects

50 YEARS
HYOSUNG

01 Key Global Customers

02 GSUT Power Factory Projects

Major power plant projects

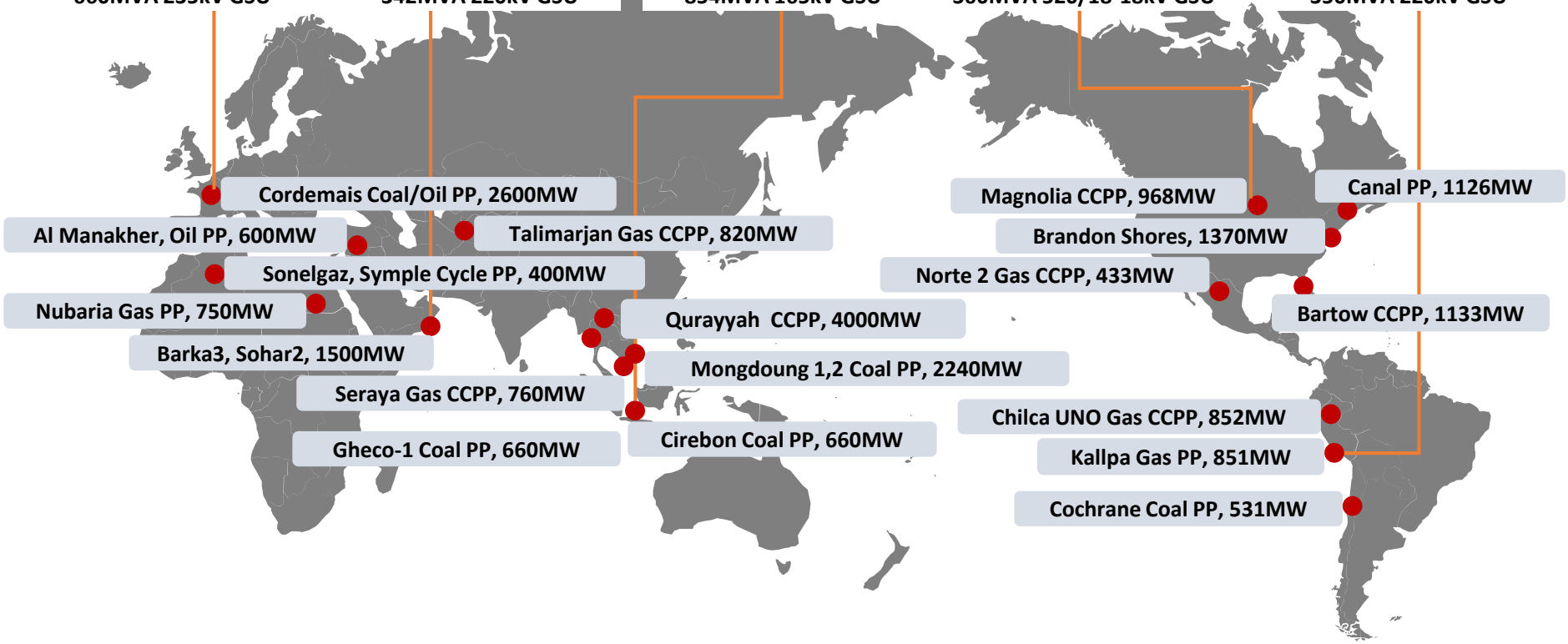
660MVA 235kV GSU

342MVA 220kV GSU

854MVA 165kV GSU

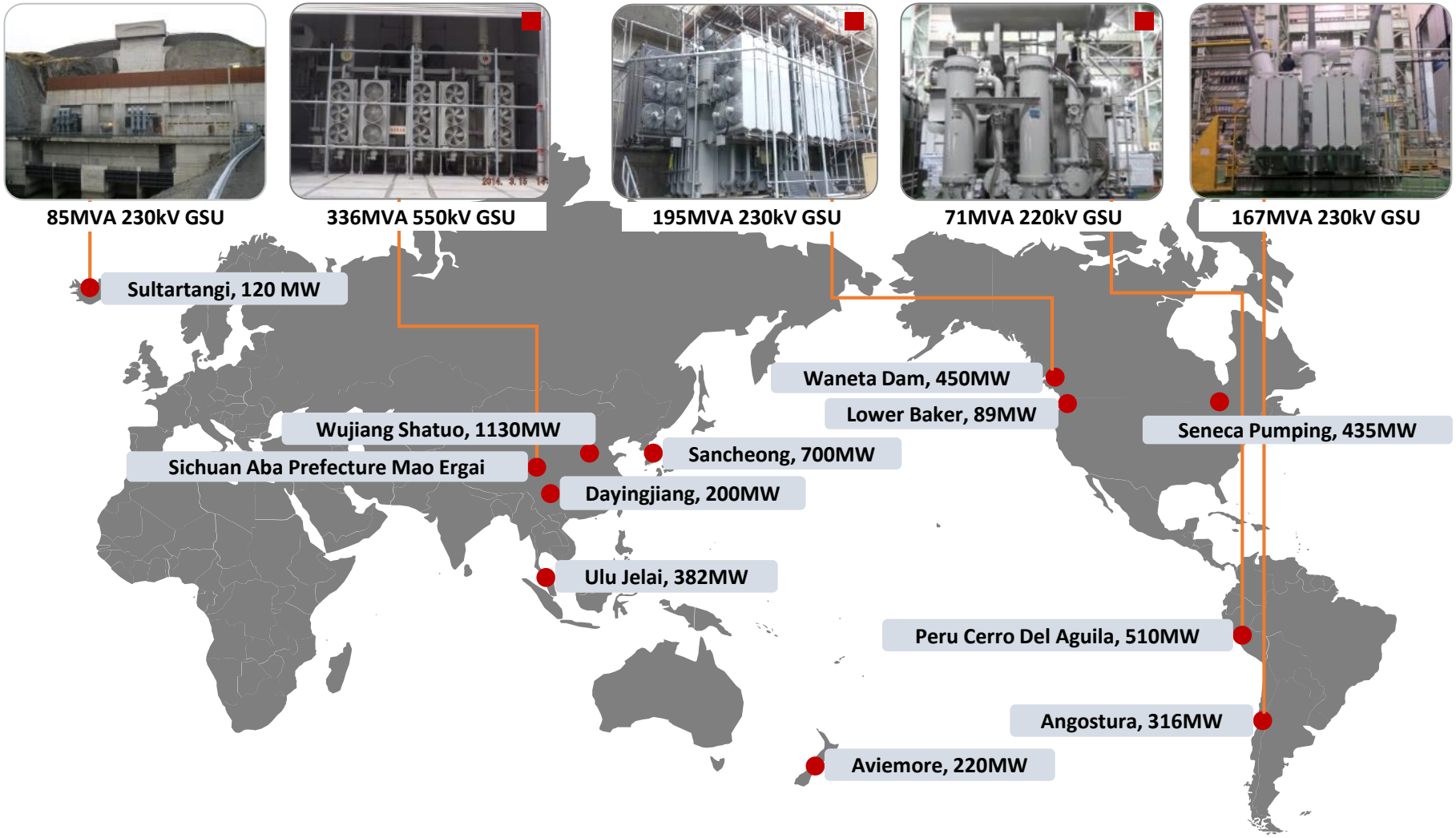
360MVA 520/18-18kV GSU

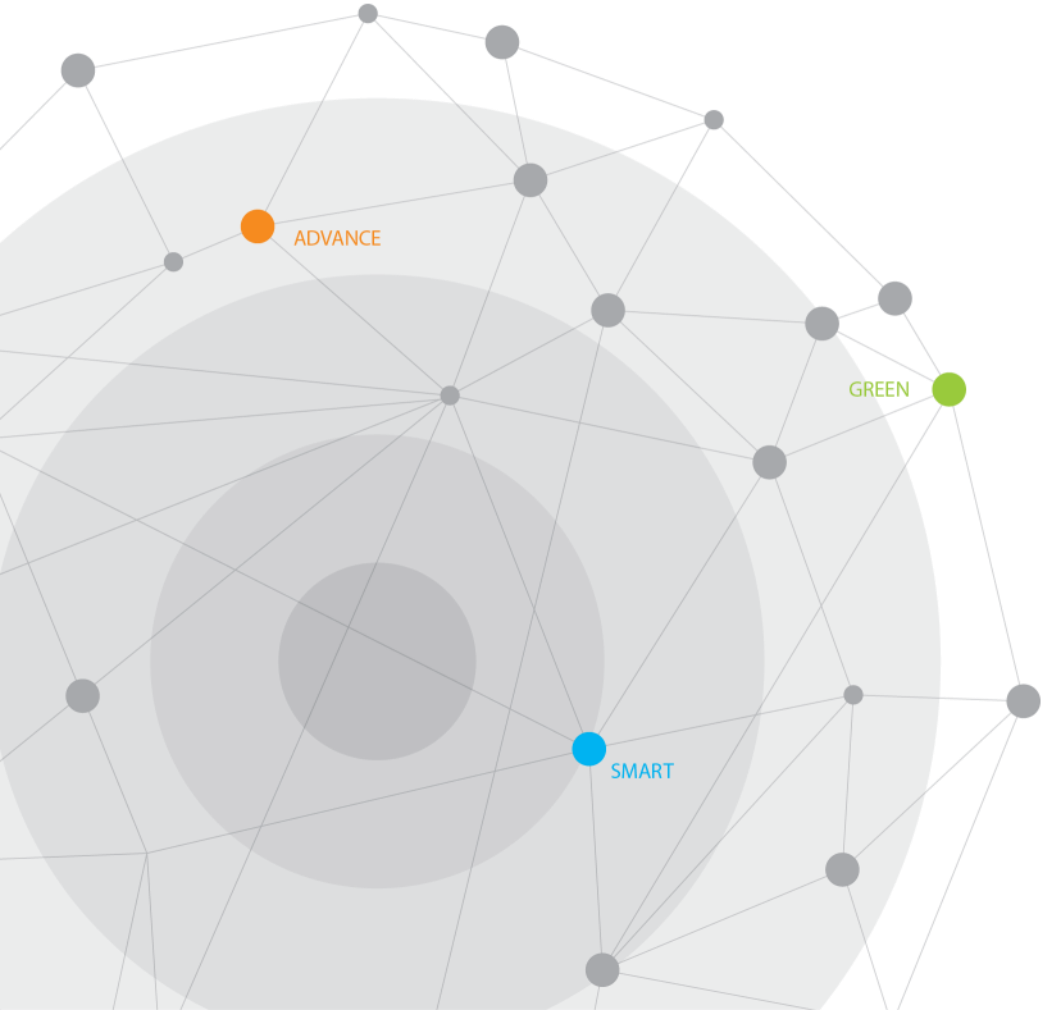
350MVA 220kV GSU



02 GSUT Hydropower Station Project

Major hydropower projects





Thank you

Global Top

Energy, Machinery & Plant

Solution Provider

HYOSUNG

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