

HICO America: The Experience and Technical Capability for a 765kV Future

Presented by: HICO AMERICA

HICO AMERICA
HYOSUNG HEAVY INDUSTRIES CORPORATION

AGENDA

- HYOSUNG ORGANIZATION STRUCTURE
- HICO AMERICA FOCUS AND EQUIPMENT
- FACTORY OVERVIEW
 - CHANGWON
 - MEMPHIS
- CAPABILITIES & EXPANSION
- REFERENCES
- ADDRESSING SUPPLY CHAIN CONCERNS



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HYOSUNG HEAVY INDUSTRIES CORPORATION

HYOSUNG HOLDINGS

HYOSUNG HEAVY
INDUSTRIES CORPORATION

HYOSUNG HEAVY
INDUSTRIES CORPORATION
CHANGWON, SOUTH KOREA

HYOSUNG HICO
MEMPHIS, TENNESSEE

HICO AMERICA
PITTSBURGH, PENNSYLVANIA

HICO AMERICA
BREA, CALIFORNIA

HICO AMERICA
GREENSBURG, PENNSYLVANIA

Factory 1

- Power Transformer,
- Gas Insulated Switchgear
- ESS, STATCOM,
- HVDC & MVDC

Factory 2

- Distribution/ Mold
- Transformer

Factory 3

- LV/ MV Motor, Gear Unit,
- Industrial Machines,
- Pump, Welding

Factory 4

- MV/ LV Switchgear

HICO America Product Lines and Services

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Power Transformers and Shunt Reactors – Small, Medium & large Power to 765kV

High Voltage GIS – 72.5kV to 800kV

High Voltage Gas Circuit Breakers – 72.5kV to 800kV

FACTS (STATCOM/HVDC/MVDC)

Medium Voltage GIS – Up to 38kV

Energy Storage Solutions

Full Engineering, Procurement & Construction Services

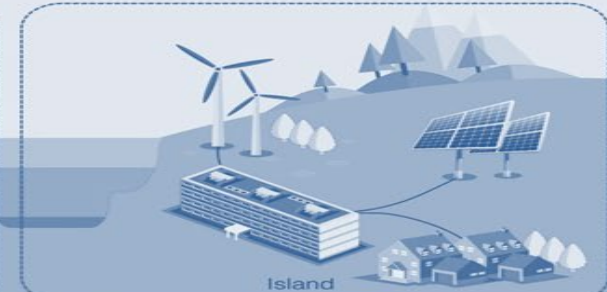
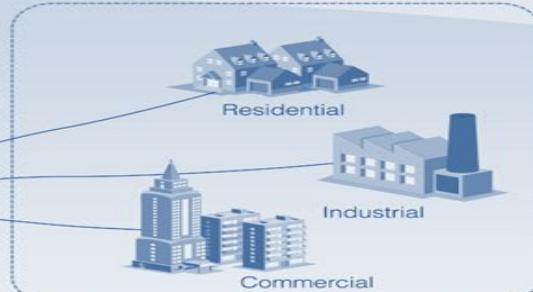
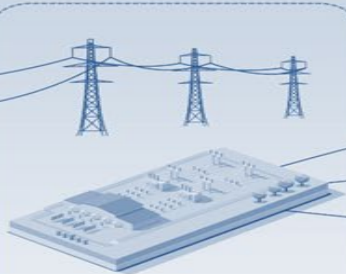
Generation

T&D

Consumption

Renewables

Off-grid



Hyosung Overview - Changwon South Korea

Total
Land Area

7,828,298 ft²

718,332 m²

180 Acre

FACTORY 2

HYOSUNG

Cast Resin Transformer

R&D Center

Distribution Transformer

Main Building

FACTORY 1

DNIS

Welding machine

PCS

GIS R&D Center

HV Switchgear

Power Transformer and Reactor

DC Solution

STATCOM

HYOSUNG

HYOSUNG

HYOSUNG

Generator

Motor

High Voltage Induction Motor

Power Transformer and Reactor

Chemical Equipment

Wind Energy System

Pump R&D center

Pump

Gear Solution

Pump

OSUNG

FACTORY 4

M/LV SWGR

CGIS

IPB

E-Panel

Insulator

Manufacturing Experience and Capabilities Including 765kV

- Power Transformer Manufacturing
 - 3000MVA, 765kV, 500T
 - Only US Manufacturing Facility for 765kV
- 350,000 Square Feet
- 400+ Employees



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Hyosung HICO's Key Historical Milestones

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FEBRUARY 2020
HYOSUNG HICO
ESTABLISHED

JUNE 2020
FIRST CORE FORM
TRANSFORMER IN
MEMPHIS

JANUARY 2023
HYOSUNG HICO
MANUFACTURES
FIRST 525kV
TRANSFORMER

December 2023
MEETS OUTPUT GOALS
FIRST TIME IN FACILITY'S
HISTORY

SEPTEMBER 2024
HYOSUNG HICO
HAS MANUFACTURED
200+ CORE FORM
TRANSFORMERS

- 
- Greensburg, PA Based Service – Domestically Mobilized
 - Dedicated High Pot Test Equipment
 - 24 Hour Service
 - Experienced Field Service Engineers and Technicians Supporting 765kV HVGIS and 765kV Circuit Breakers

765kV Design Aspects for Success

Engineering

Transient Voltage Analysis Required for Safe Operation for the Life of the Transformer

Winding Design Technology Required to implement linear transient voltage distribution

Significant focus on temperature rise calculations, and short circuit analysis

Versatility to utilize different core designs for 1ph units

Capability to Implement Efficient Winding Displacement

Capability to limit variations in design-test results



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765kV Design Aspects for Success

Manufacturing

Requires the best equipment and Tools on Hand

Winding Machines with sufficient outer-most diameters

Vaporphase Drying Machine to Accommodate physical size of the transformers

Sufficient crane capacity to lift active parts

Sufficient vacuum pump capacity to process units and ensure dryness

Focus on contamination control and operating clean rooms

Strict control of moisture and humidity in the facility



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765kV Design Aspects for Success

Testing Capabilities

Impulse Generator – 5,200kV, 780kJ to Accurately Test 765 Class Transformers

Capacitor Bank – 480MVAR (3-Phase) to conduct
Temperature Rise Tests

Sufficient capacity for production throughput of units



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765kV GLOBAL REFERENCES FOR TRANSFORMERS & SHUNT REACTORS

COUNTRY	RATING	TYPE	QUANTITY	YEAR
KOREA	1PH 765/345kV 333MVA	AUTO	3	1992
KOREA	1PH 765/345kV 666MVA	AUTO	3	2001
KOREA	1PH 765/345kV 666MVA	AUTO	4	2002
KOREA	1PH 765/20.9kV 395MVA	AUTO	7	2009
KOREA	1PH 765/345kV 666MVA	AUTO	16	2009-2010
INDIA	1PH 765/400kV 500MVA	AUTO	62	2010-2012
KOREA	1PH 765/345kV 666MVA	AUTO	6	2014
KOREA	1PH 765/20.9kV 204MVA	AUTO	12	2016-2018
KOREA	1PH 765/345/34.5kV 750MVA	AUTO	3	2016
KOREA	1PH 765/345/23kV 333MVA	AUTO	4	2018
INDIA	1PH 765kV 110MVA _r	SHUNT REACTOR	10	2011-2012
INDIA	1PH 765kV 80MVA _r	SHUNT REACTOR	7	2011-2012

TRANSFORMERS – 120

SHUNT REACTORS - 17

HICOs 765kV Transformer and Shunt Reactor References - USA

Equipment Rating	Type	In-Service Year	Quantity
1PH 765/345kV 750MVA	Auto	2012	7
1PH 765/138/13.8kV 250MVA	Auto	2014	3
1PH 765/345/34.5kV 750MVA	Auto	2014	12
1PH 765/345/34.5kV 750MVA	Auto	2015	7
1PH 765/138/13.8kV 250MVA	Auto	2016	1
1PH 765/345kV 750MVA	Auto	2016	4
1PH 765/345kV 750MVA	Auto	2017	8
1PH 765/138/13.8kV 250MVA	Auto	2017	4
1PH 765/138/13.8kV 250MVA	Auto	2018	8
1PH 765/345/34.5kV 750MVA	Auto	2019	3
1PH 765/138/13.8kV 250MVA	Auto	2021	6
1PH 765kV 50mVAR Shunt Reactor	Shunt Reactor	2016	4
1PH 765kV 50mVAR Shunt Reactor	Shunt Reactor	2017	4

TRANSFORMERS – 63

SHUNT REACTORS - 8

HICOs 765kV Circuit Breaker References - USA

Nominal Voltage	765kV
Rated Voltage	800kV
Frequency	60Hz
Breaking Current (Short-Time Withstand)	63kA (3 Sec)
Breaking Time	2 Cycles
Making Current	164kAp
Breaker per Pole	1
First Pole to Clear Factor	1.3
Rated Current	4000A/5000A
Rated Power Frequency Withstand Voltage (1 min)	960kV
Rated Lightning Impulse Withstand Voltage (1.2/50 μ s)	2050kV
Operating Mechanism	Spring/Spring
Mechanical Endurance Class	M2 (10,000)
Capacitive Current Switching Class	C2
Testing Standard	IEEE
Re-Closing Duty	O-0.3s-CO-3m-CO
Type Tested Certified by	KERI/KEMA



Voltage	Breaking Current	Quantity	Year
800kV	63kA	1	2011
800kV	63kA	1	2013
800kV	63kA	8	2014
800kV	63kA	8	2015
800kV	63kA	6	2016
800kV	63kA	2	2017
800kV	63kA	9	2018
TOTAL UNITS		35	

800kV HV Gas Insulated Switchgear

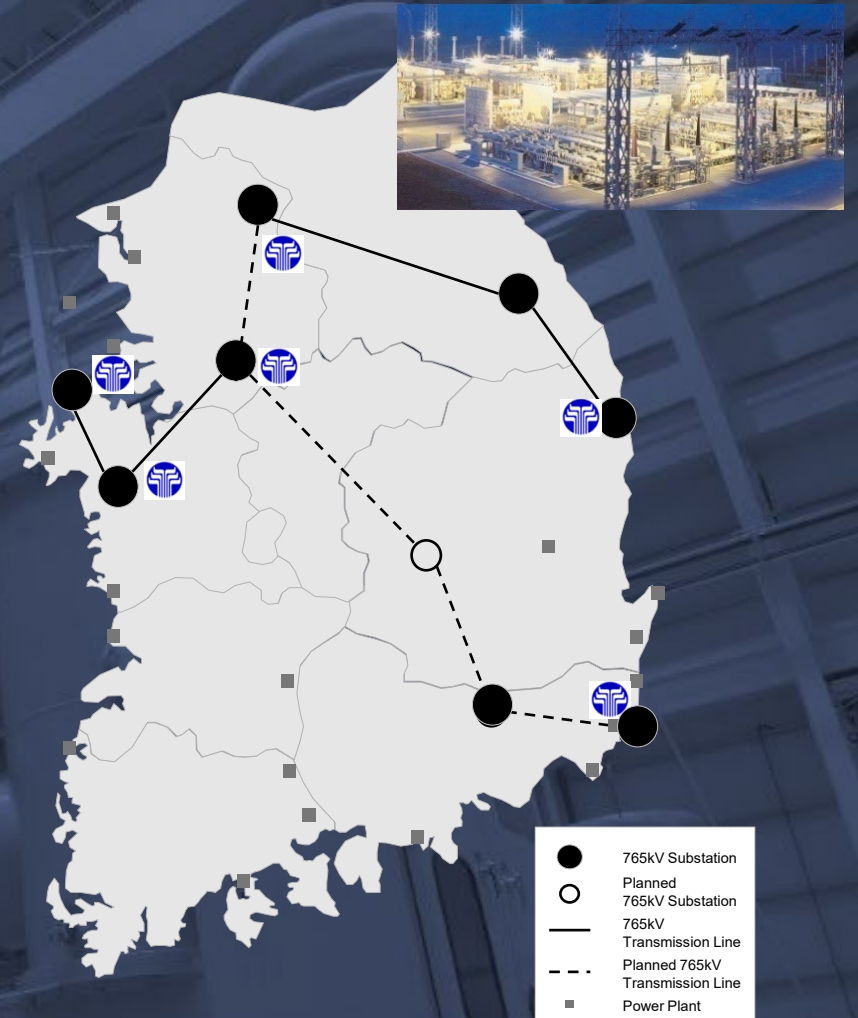
Nominal Voltage	765kV
Frequency	60Hz
Breaking Current (Short-time Withstand)	63kA
Breaking Time	2 Cycles
Making Current	164kAp
Breaker per Pole	1
First Pole to Clear Factor	1.3
Rate Current	5000A
Rated power frequency withstand voltage (1 min)	960kV
Rated lightning impulse withstand voltage (1.2/50 μ s)	2050kV
Operating Mechanism	Hydraulic
Mechanical Endurance Class	M2 (10,000)
Capacitive Current Switching Class	C2
Re-Closing Duty	O-0.3s-CO-3min-CO
Type Test Certified by	KERI/KEMA



HIGH VOLTAGE GIS REFERENCES - KOREA

Voltage	Breaking Current	Quantity	Year
800kV	50kA	4	1999
800kV	50kA	16	2000
800kV	50kA	4	2001
800kV	50kA	6	2002
800kV	50kA	5	2003
800kV	50kA	2	2004
800kV	50kA	3	2005
800kV	50kA	11	2008
800kV	50kA	2	2010
800kV	50kA	4	2011
800kV	50kA	2	2013
800kV	50kA	2	2014

TOTAL UNITS	55
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HICO Addressing EHV Capacity and Supply Chain Concerns



Offshore Wind, USA

First Offshore Wind in USA

- Three phase
- 160 MVA 138KV ONAF
- Delivered 2023



Transmission, USA

- Three Phase AUTO
- 400 MVA 542kV with OLTC on HV
- Delivered 2023



Transmission, USA

- Three phase GSU
- 145 MVA 500/34.5kV ONAF
- Delivered 2023



Transmission, USA

- Three phase
- 62.5 MVA 115KV with OLTC & DETC
- Delivered 2022

HICO Addressing EHV Capacity and Supply Chain Concerns

- Dedicated Production Slot Reservations for EHV and 765kV Customers
- Dedicated Production Slot Reservations for 800kV GIS and Circuit Breakers
- Working with Key Suppliers to Identify Supply Chain Concerns on Long Lead Items
- Commitments to North American Suppliers to Avoid Additional Supply Chain Risks



Thank You & Questions

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