



FACTS

(Flexible AC Transmission System)

CONTENTS

- 01 What is FACTS?
- 02 Applications of FACTS(SVC, STATCOM)
- 03 LS ELECTRIC FACTS Solution
- 04 References

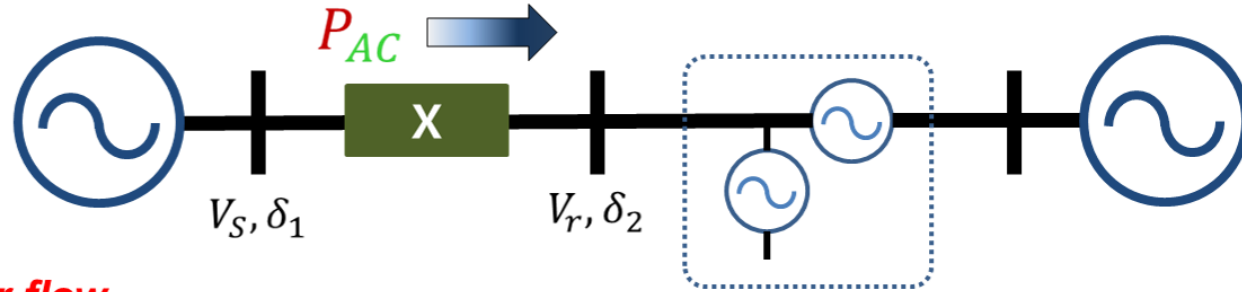
1. What is FACTS?

What is FACTS ?

Term "FACTS" means Flexible AC Transmission System

FACTS is defined by the IEEE as "a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability"

FACTS



support of power flow

FACTS

Parallel Compensation

MSC, MSR, **SVC, STATCOM**, Sync.mach.

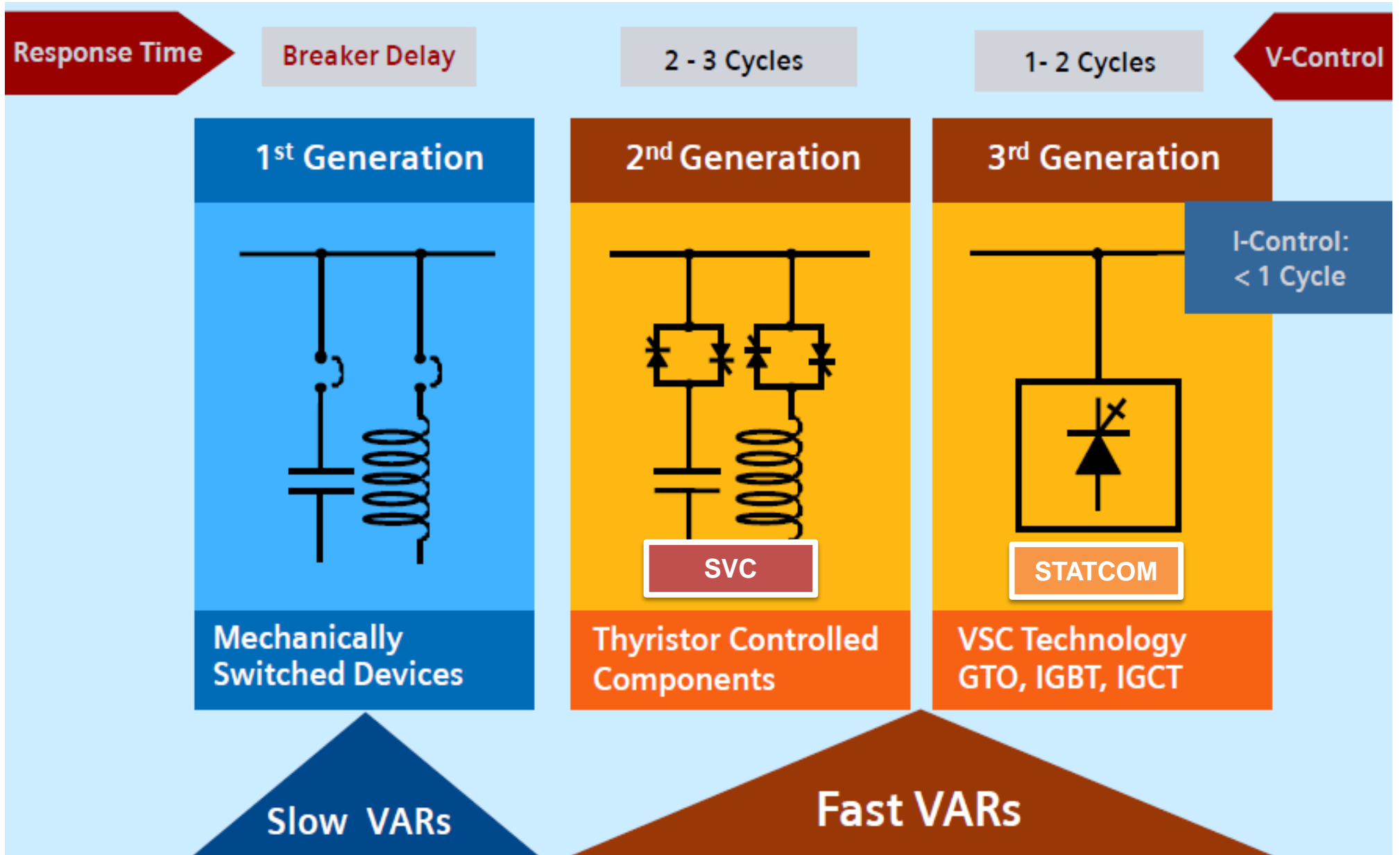
Series Compensation

TCSC, SSSC, UPFC, IPFC

$$P_{AC} = \frac{V_S \cdot V_r}{X} \sin(\delta_1 - \delta_2)$$

LS ELECTRIC FACTS solution has SVC and STATCOM

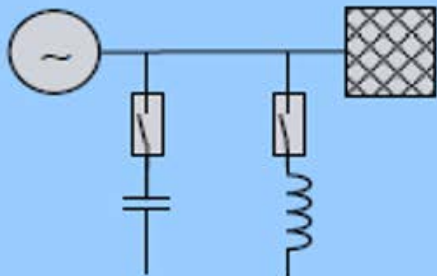
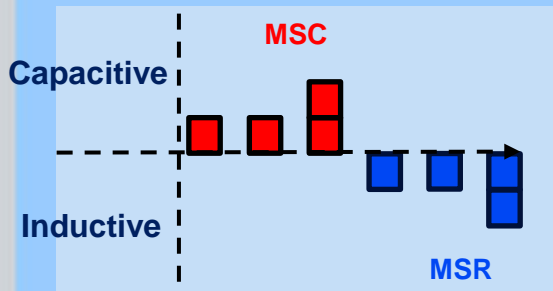
* MSC : Mechanical Switched Capacitor * MSR : Mechanical Switched Reactor * SVC : Static Var Compensator * STATCOM : Static synchronous Compensator
 * TCSC : Thyristor Controlled Series Compensator * SSSR : Static Synchronous Series Compensator * U/IPFC : Unified/Interline Power Flow Controller



MSC / MSR

Mechanical Switched Capacitors / Reactors

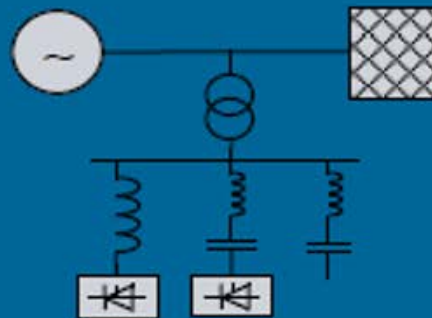
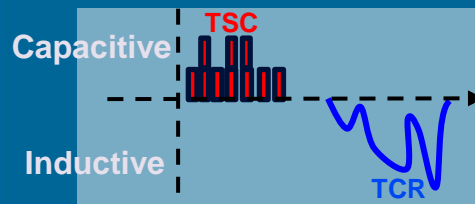
- ➔ Switchgear
- ➔ Capacitors
- ➔ Reactors



SVC

Static Var Compensator

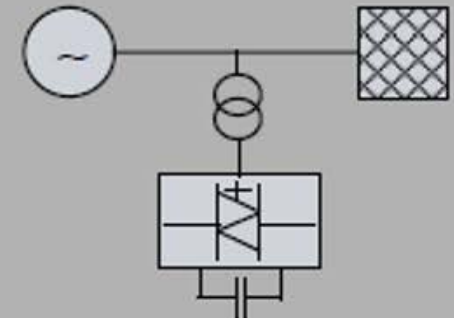
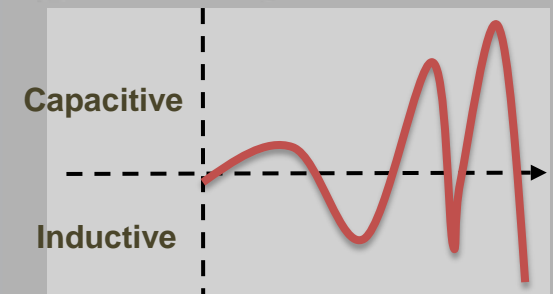
- ➔ Thyristor Valve(s)
- ➔ Control & Protection
- ➔ Transformer
- ➔ Capacitors
- ➔ Reactors



STATCOM

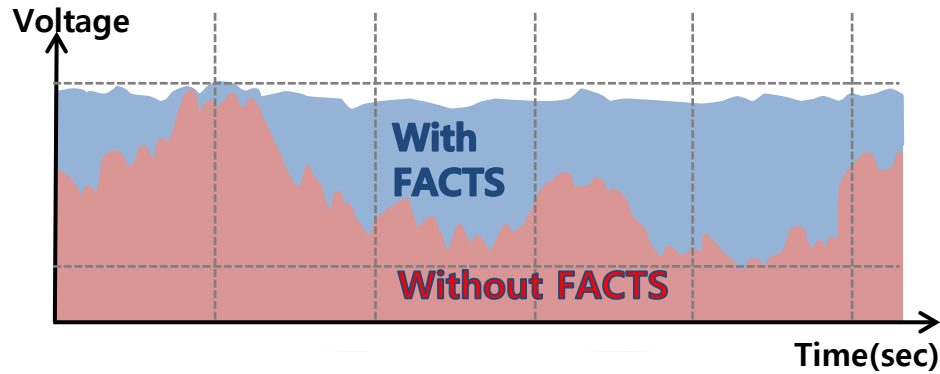
Static Synchronous Compensator

- ➔ GTO/IGBT Valves
- ➔ Control & Protection
- ➔ Transformer
- ➔ DC Capacitors



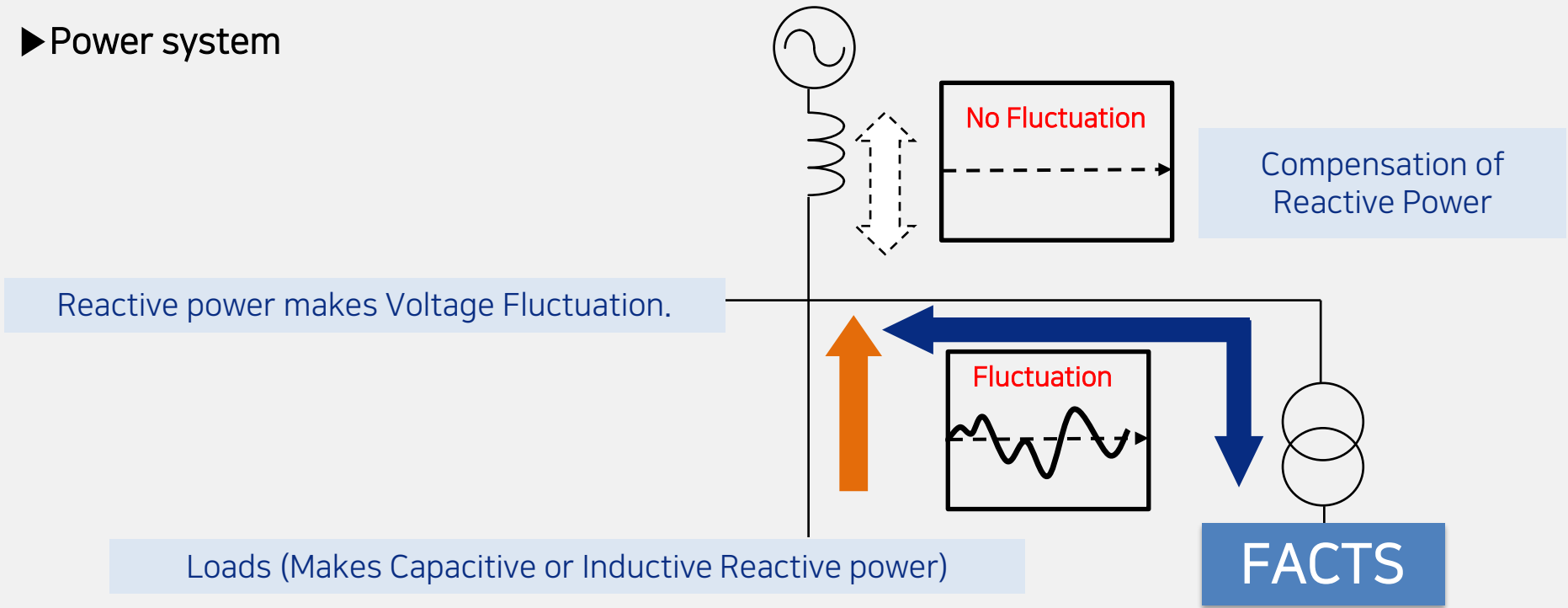
2. Applications of FACTS (SVC, STATCOM)

Main Purpose



- ✓ Over/Under voltage suppression
- ✓ Balancing of Reactive power
- ✓ Stabilization of system voltage

► Power system



Applications

**Power Utility****Railway****Renewable
Energy****Steel**

- Regulate Voltage
- Increase Power Transfer Capacity
- Increase AC Network Reliability
- Improve transient & Steady-State Stability
- Decrease Power Oscillation
- Strike a Balance of Three-Phase Voltage
- Compensate Reactive Power
- Suppress Flicker
- Support Renewable energy

3. LS ELECTRIC FACTS Solution

FACTS solution

- System Engineering
- Provides an optimized solution
- Main Equipment manufacture(Tr., Valve, Control and Protection etc.)

	SVC	STATCOM	P-STATCOM
Type	TCR + TSC + FC	MMC STATCOM	Panel STATCOM
Foot Print	Depends on the capacity	Depends on the capacity	Depends on the capacity
Delivery	18 months ※ Standard	18 months ※ Standard	2 months ※ Standard
Component	<ul style="list-style-type: none"> · TSC : Thyristor valve · TCR : Thyristor valve · FC : Fixed capacitor 	<ul style="list-style-type: none"> · MMC Valve : Full-bridge type · Phase reactor · Transformer 	<ul style="list-style-type: none"> · PEBB : Module type converter · AC panel · HMI/Control device
Solution	±100~ ±500Mvar	±100~ ±500Mvar	±125kvar~ ±2Mvar

* MMC : Modular Multi-level Converter, TCR : Thyristor Controlled Reactor, TSC : Thyristor Switched Capacitor

Compact FACTS solution

- System Engineering
- Provides an optimized solution
- Main Equipment manufacture(Tr., Valve, Control and Protection etc.)

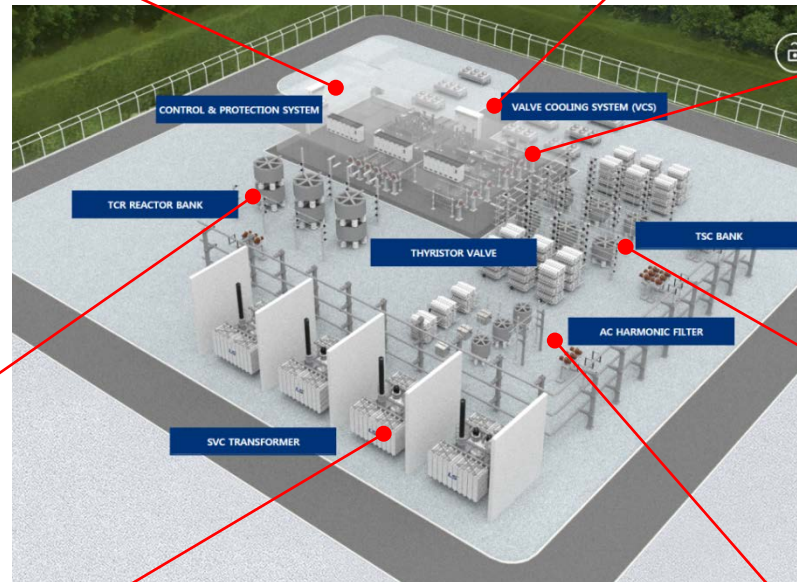
	MOBILE	CONTAINER	E-HOUSE
Type	MMC STATCOM	MMC STATCOM	MMC STATCOM
Foot Print	45 x 20 (900m ²)	42m x 20m (840m ²)	45m x 16m (720m ²)
Delivery	18 months ※ Standard	18 months ※ Standard	14 months ※ Standard
Component	<ul style="list-style-type: none"> · M.Tr : trailer (plug in cable) · VSC : container on trailer · reactor : fixed ground 	<ul style="list-style-type: none"> · M.Tr : fixed ground · VSC : container · reactor : fixed ground 	<ul style="list-style-type: none"> · M.Tr : fixed ground · VSC : E-House · reactor : fixed ground
Solution	±50~±200Mvar (±50Mvar x 4bank)	±50~±200Mvar (±50Mvar x 4bank)	±100~±200Mvar (±100Mvar x 2bank)

* MMC : Modular Multi-level Converter,

* VSC : Voltage Source Converter

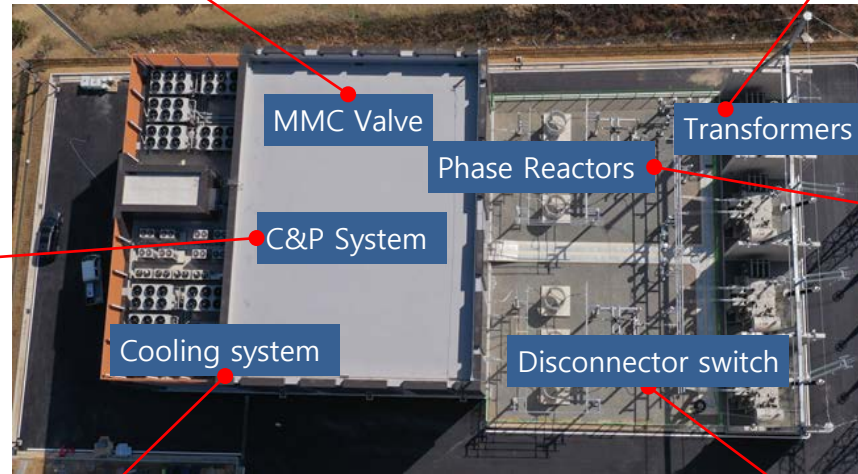
SVC solution (Building type)

- PJT : Shin-Jaechun S/S SVC Project
- Capacity : -225~+675Mvar
- Customer : KEPCO
- Completion : 2019. 06
- Remark : Voltage Control



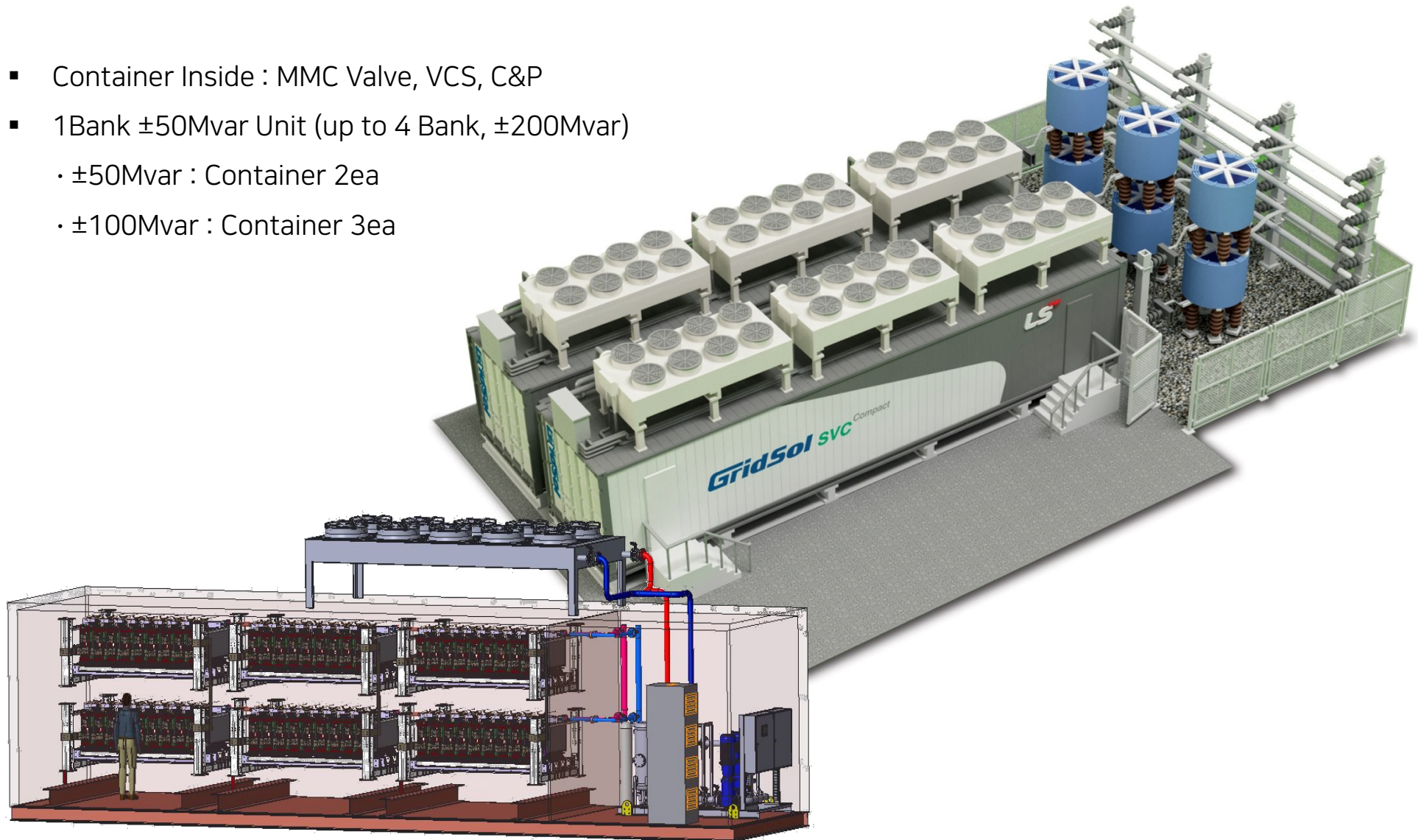
MMC STATCOM solution (Building type)

- PJT : Godeok S/S STATCOM Project
- Capacity : $\pm 300\text{Mvar}$
- Customer : KEPCO
- Completion : 2020. 07
- Remark : Voltage Control



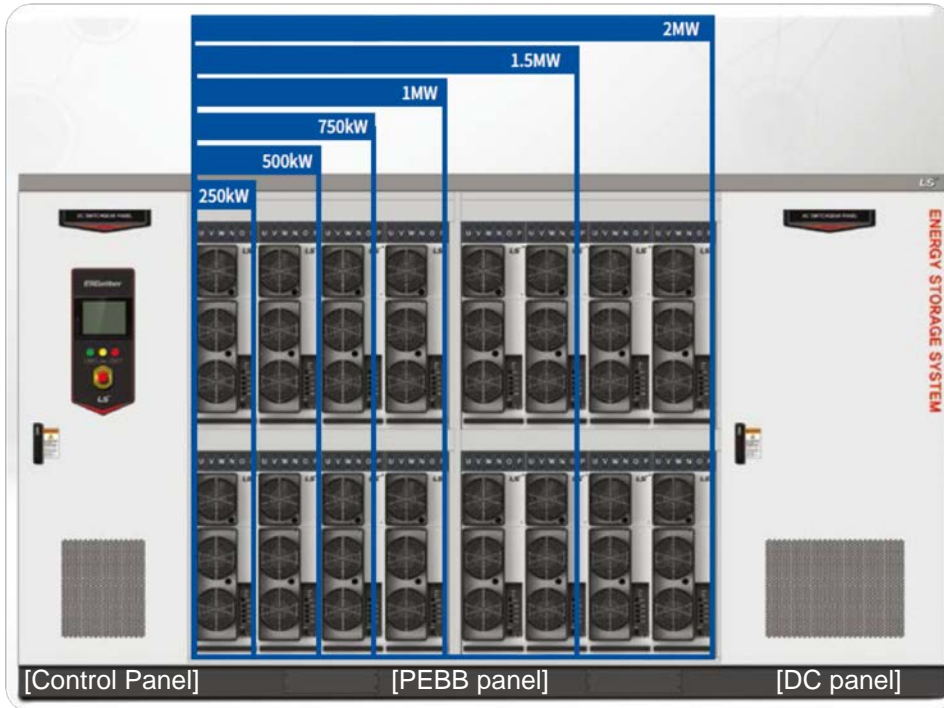
Compact FACTS Solution (container type)

- Container Inside : MMC Valve, VCS, C&P
- 1Bank $\pm 50\text{Mvar}$ Unit (up to 4 Bank, $\pm 200\text{Mvar}$)
 - $\pm 50\text{Mvar}$: Container 2ea
 - $\pm 100\text{Mvar}$: Container 3ea

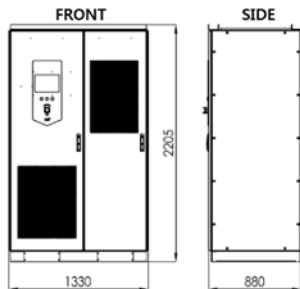


PNL FACTS Solution (panel type)

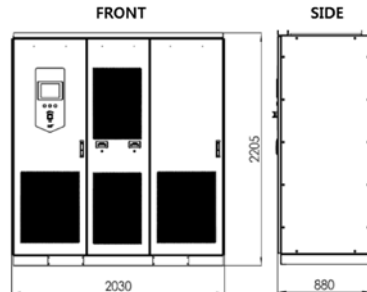
■ Scalable Module Applying 125kvar PEBB



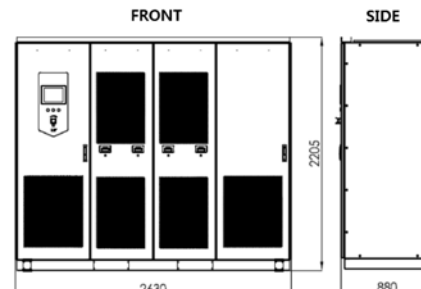
- Automatically continued operation, after withdrawing the failed PEBB, when a 125kvar PEBB fails.
- The block type enables quick module replacement and maintenance.
- 97% or higher efficiency → Minimized loss.
- Different panel configurations according to the capacity.



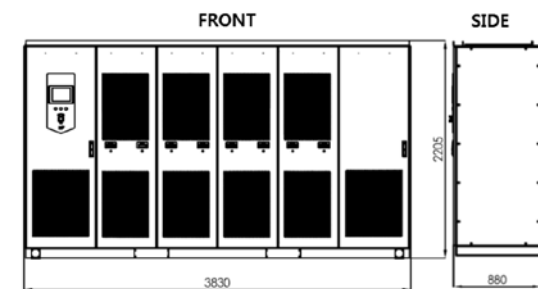
250kvar / 1300 x 880 x 2205



500kvar / 2030 x 880 x 2205

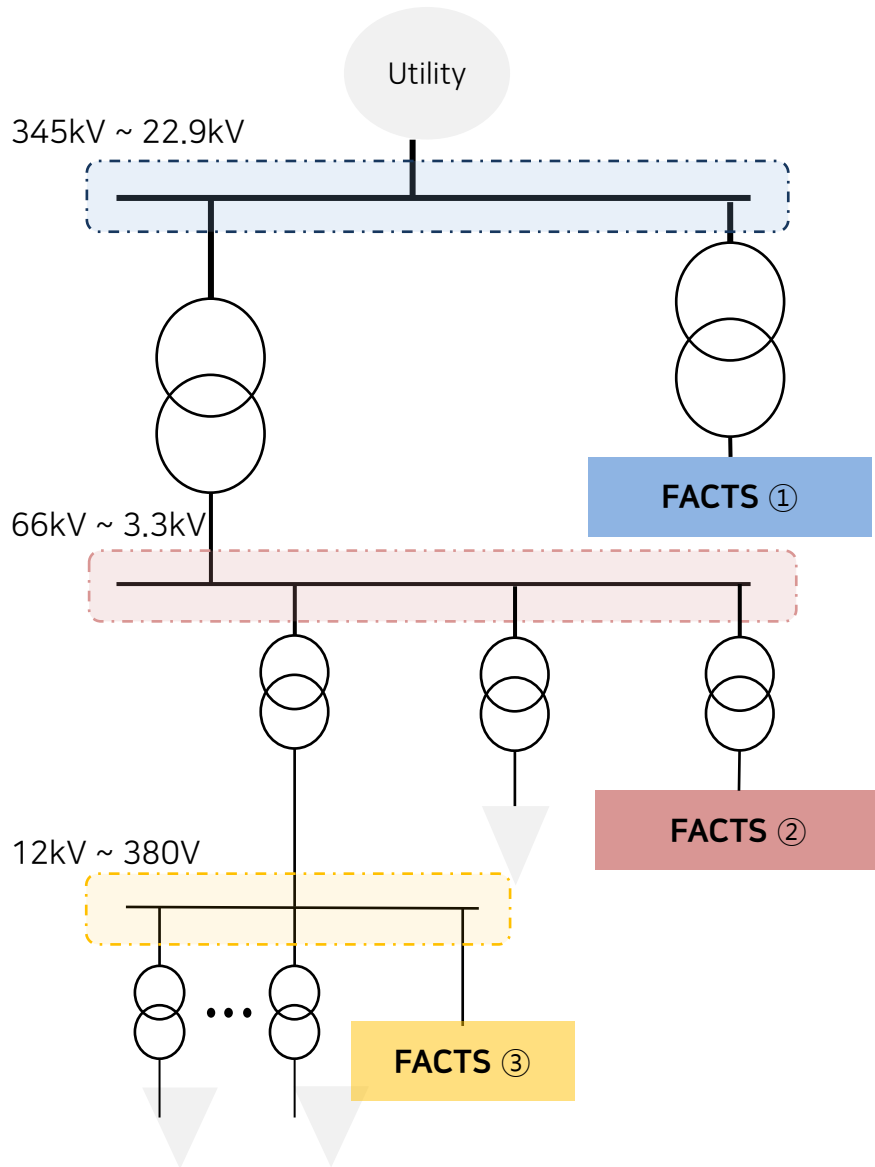


1Mvar / 2630 x 880 x 2205



2Mvar / 3830 x 880 x 2205

Optimal FACTS Solution According to the Applied System Characteristics



- Factory power quality improvement, at the power system's interface bus layer
- High-voltage and large-capacity system suitable for building and container types
- Applicable to SVC and STATCOM systems
- Compensation for numerous Mvar
- Prevention of the effects of system (lead line) voltage fluctuations
- Meeting the criteria for power factor, harmonics, and flicker

- Possible installation of the highest-voltage bus layer inside the factory
- Suitable compensation for 100Mvar or less, capacity
- Applicable to building, container, and panel types
- Applicable to SVC and STATCOM systems
- Prevention of the effects of system voltage fluctuations
- Meeting the criteria for power factor, harmonics, and flicker

- Suitable for panel-type STATCOM systems
- Directly connectable to low-voltage load buses of 380V and 440V
- Connectable to up to 12kV when using a transformer
- Compensation for up to 24Mvar through the parallel connection of 12 units
- Reduced impact (voltage, power factor, harmonics, etc.) terminal load

4. References

References

- Reactive power compensation facility supply for power stabilization in the private sector, through a consortium with overseas manufacturers
- Compensation facility supply for large capacity reactive power by securing internal FACTS & HVDC know-how and product development (SVC and STATCOM)

No.	Customer	System Voltage	Capacity	Type	USE	Completion	Manufacturer
1	SeahBesteel	22kV	±90Mvar	TCR, FC	Compensation of Fast Reactive Load Variations	2005	Consortium (LSIS + TMEIC)
2	POSCOSS	33kV	±125Mvar	TCR, FC	Compensation of Fast Reactive Load Variations	2006	Consortium (LSIS + ABB)
3	Hwan-young	22kV	±80Mvar	TCR, FC	Compensation of Fast Reactive Load Variations	2007	Consortium (LSIS + TMEIC)
4	KOSCO	22kV	±120Mvar	TCR, FC	Compensation of Fast Reactive Load Variations	2008	Consortium (LSIS + ABB)
5	KEPCO	154kV	±200Mvar	TCR, TSC	Voltage Control	2008	Consortium (LSIS + TMEIC)
6	ASIASS	22kV	±80Mvar	STATCOM	Compensation of Fast Reactive Load Variations	2009	Consortium (LSIS + ABB)
7	KEPCO	154kVac / 80kVdc	60MW	HVDC (Pilot)	Transmission	2014	LSIS
8	LS-Nikko	22kV	±100Mvar	TCR, TSC	Power Factor Voltage Control	2015	LSIS
9	SeahBesteel	22kV	±90Mvar	TCR, HF	Compensation of Fast Reactive Load Variations	2016	LSIS
10	KEPCO	345kV	-225 / +675Mvar	TCR, TSC, HF	Voltage Control	2019. 4	LSIS
11	KEPCO	345kV	±300Mvar	MMC STATCOM	Voltage Control	2020. 5	LS ELECTRIC

köszi,
ευχαριστώ
mahadsanid
vinaka
gracias
diolch
dzięki
foole tunk
danke
tack
aguyje
tānan
kiitos
paxмет
takк
mersi

hvala
obrigado
mahalo
gracies
tack
dankon
tānan
chokran
Баярлалаа
mulumesc
aguyje
xвала
dankie

grazias
danke
vinaka
diolch
zi
благодаря
aciū
asante

kiitos
nèà' ešè
kia ora
gracies
weebale
merci
tānan
hvala
dankon
gracias
tānan
weebale
spaci bo
shukuriyaa
kiitos
tack
mulumesc
gracies
weebale
mersi
hvala
dankie
dēkuju

aguyje
Дзякуй
qujanaq
Dakulem
gracias
aciū
cam on ong
dankie
makasih ya
aciū
kiitos
dankon
villmols
merci
Благодарам
gura mile
tige tank
mahalo
dankon
dzięki
dankie

weebale
terima kasih
mange tak
kia ora
shukuriyaa
qujanaq
grazas
tapadh leat
faleminderit
mauruuru
grazzi hafna
aguyje

köszi
nais
Дзякуй
hvala
tige tank
obrigado
dzięki
paldies
ngiyabonga
villmols
merci
teşekkürler