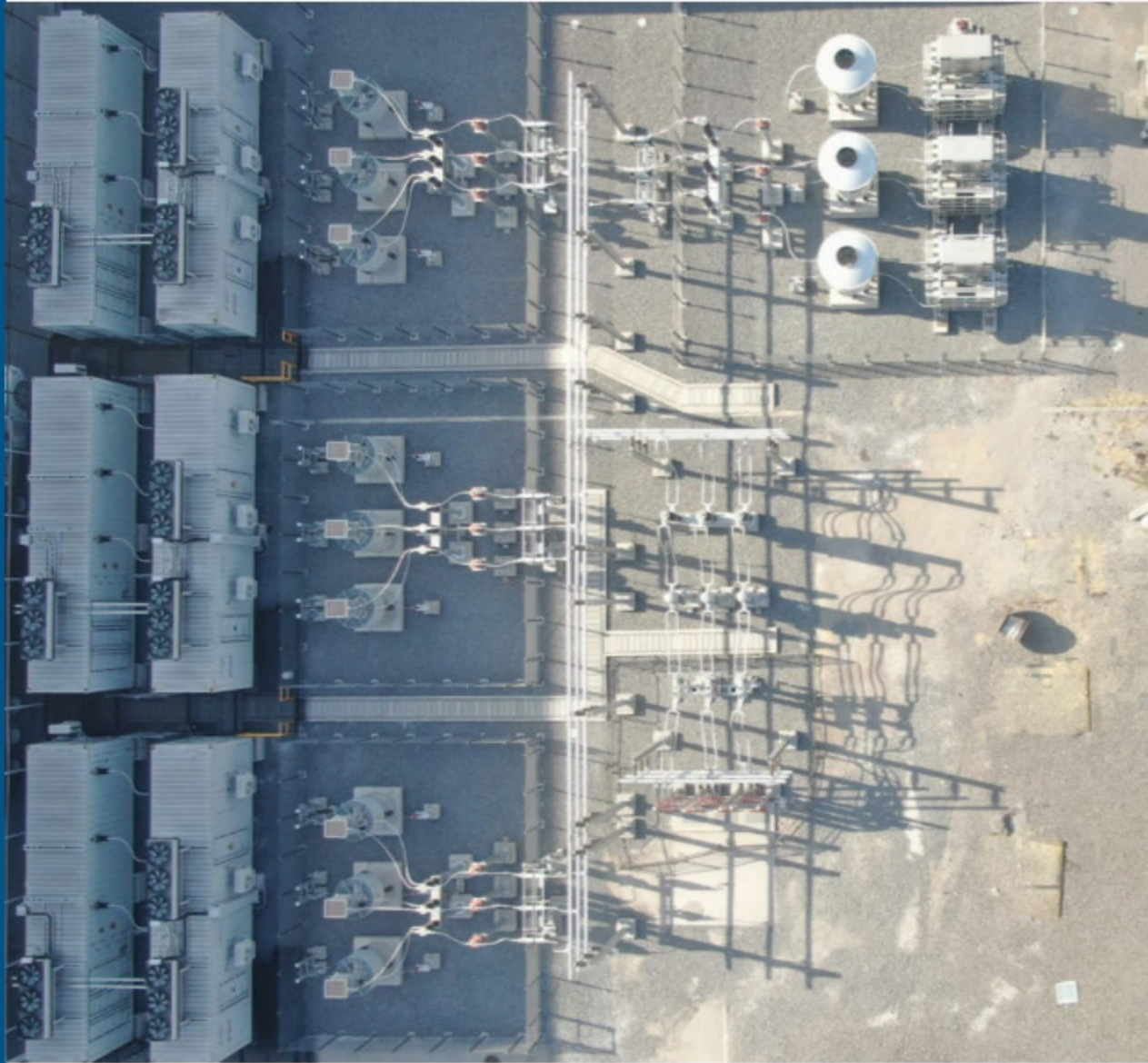


STATCOM & SVC

FACTS (Flexible AC Transmission Systems)

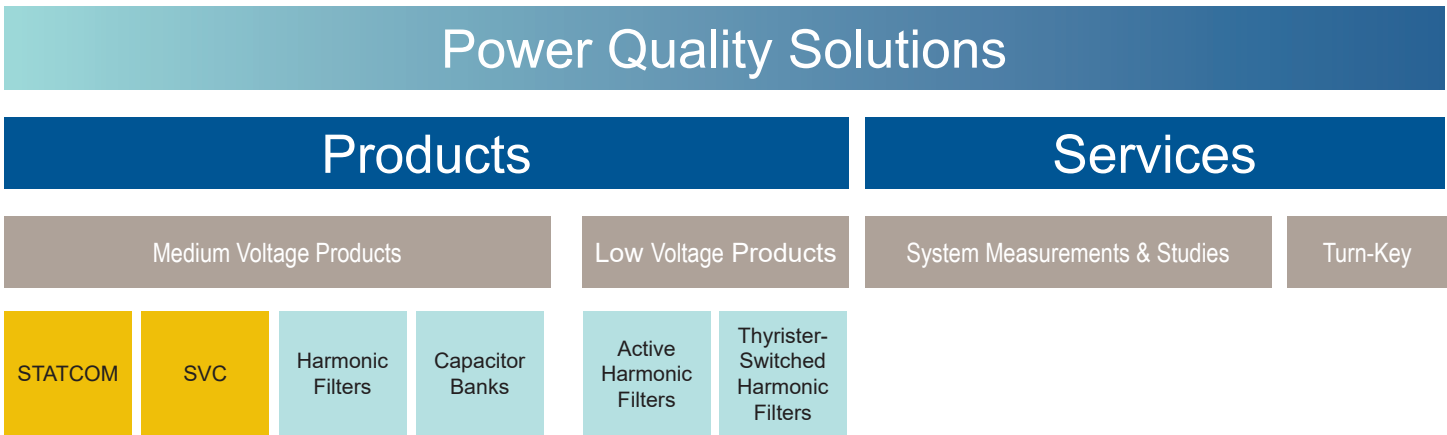


The Power System Solutions Division combines the strengths of Southern States and Diram, a leader in power quality solutions for the industrial and utility markets. Our team of power engineers and technicians are experts in system planning, specification guidance, engineering, turn-key construction services, implementation of reactive power compensation, and power quality optimization.

In this bulletin we will explore the technical characteristics, benefits, and applications of STATCOM & SVC Solutions.

POWER SYSTEM SOLUTIONS

Through strategic investment, Southern States has partnered with Diram, a leader in power quality solutions to form the Power System Solutions Division to offer not only products but also system planning, specification guidance, engineering, turn-key construction services, and on-site & remote technical support.



What are the FACTS?



FACTS (Flexible AC Transmission Systems) integrate high power electronics into solutions dedicated to improving and stabilizing power systems.



At Southern States we offer the most advanced technology available for regulating and stabilizing transmission & distribution systems, renewable generation and large variable loads.

STATCOM



Static Synchronous Compensator

Fastest solutions available for Dynamic Voltage/VAR compensation

Active harmonic filtering capability

Smallest footprint per kvar

Newest, most reliable technology available

Applications

Proper selection and configuration of equipment can offer substantial benefits

Renewable Generation, Transmission & Distribution

Power factor control and voltage regulation is a must for renewable generation to **comply grid code requirements**.

- Mitigate harmonics
- Meet voltage & power factor requirements
- Stabilize grid voltage
- Reduce transmission losses
- Balance three-phase power
- Improve transient stability
- Increase line capacity
- Damp power oscillations



Steel Industry



A steady voltage and low harmonic content, **increases productivity**

- Reduce electrode consumption
- Increase refractory life
- Garner more favorable tariffs
- Reduce outages

Heavy Industry



Load evolution demands faster and more efficient solutions to **avoid downtime** and **increase equipment life**.

- Energy cost reduction
- Reduce outages
- Increase productivity
- Comply grid code requirements

Operating Principle

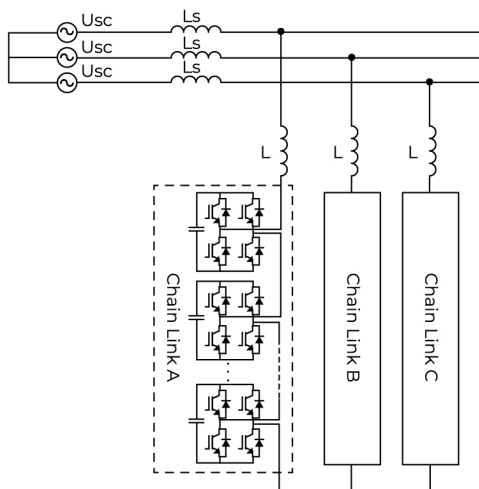
STATCOM is the newest VAR compensation technology available. The system is connected in parallel to the grid, generating a voltage waveform synchronized with the grid. Controlling the output voltage magnitude and frequency we can inject a rapidly changing current to follow the load reactive power requirements.

Work Mode	V-I waves	Description
No Load		If both voltages are equal, there is no current Flow.
VAR Generation		If the STATCOM voltage is higher, it will deliver VARs to the grid
VAR Absorption		If the STATCOM voltage is lower, it will absorb VARs from the grid

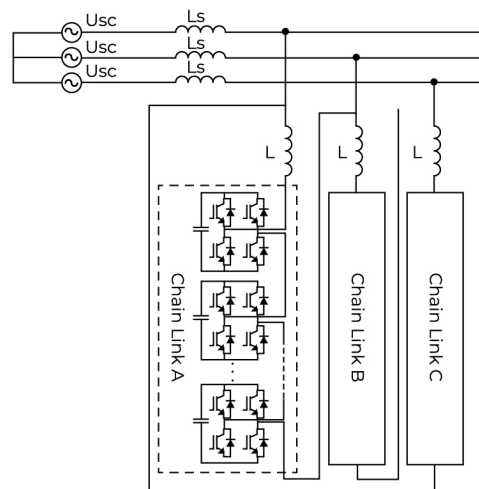
STATCOM Topology

The cascaded H-bridge, multi-level technology enables the STATCOM to generate an almost perfect sinusoidal waveform with high efficiency by reducing the IGBT switching frequency and the need for harmonic filters.

Two inverter topologies are available: Wye connection for applications where only balanced compensation is required (more economical). And Delta connection to provide balanced and unbalanced correction as required.



Wye Connection



Delta Connection

Technology

Main Components



Control and Protection

Equipped with a friendly HMI interface, our STATCOM offers ease of operation and multifunctional control settings. The system features remote real-time monitoring capabilities.

Cooling system

Air/water or water/water cooling options are available. Our systems are designed with water pump redundancy for greater reliability.

Power Unit

This is the key element of the STATCOM. Our design offers high voltage with extremely low harmonic distortion using a low switching frequency that reduces power losses. We offer Wire-Bond or Press-Pack IGBTs.

Reactor

Air core reactors offer high power density solutions. For some ratings and topologies, we can offer iron core, indoor reactors contained within the STATCOM for even a smaller footprint.

STATCOM Capabilities

Power

3-300 MVAR

Voltage

2.4-69 kV

Type

Indoor (electrical room)
Outdoor (container)

Connection

Wye or
Delta

IGBT Technology

Wire bond
Press Pack

Cooling

Air - Water
Water - Water



SVC



Static VAR Compensator

Fast dynamic power factor compensation

Most common solution for transmission lines

Lower cost per kvar for larger systems (>80 Mvar)

Applications

Proper selection and configuration of equipment can offer substantial benefits

Transmission

SVC offers to **enhance efficiency and reliability** in transmission lines. By increasing transfer capability, reducing transmission losses, and improving voltage stability.

- Stabilize grid voltage
- Reduce transmission losses
- Increase line capacity
- Balance three phase power
- Improve transient stability
- Damp power oscillation



Steel Industry

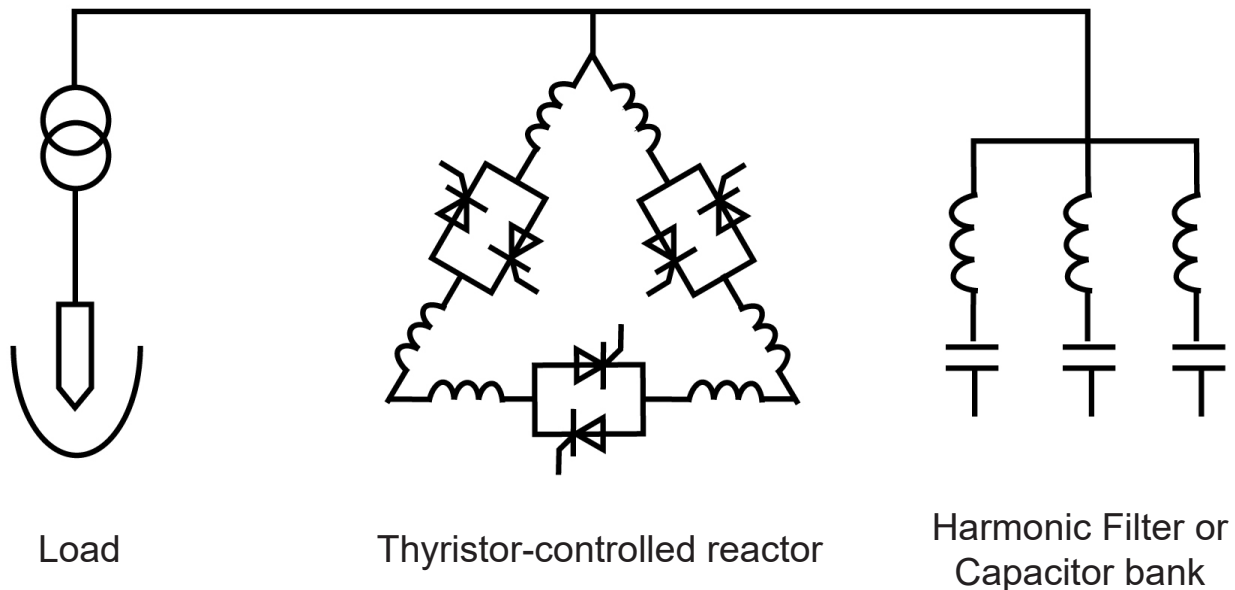
A steady voltage, **increases productivity**

- Reduce electrode consumption
- Increase refractory life
- Favorable tariff
- Reduce outages



Operating Principle

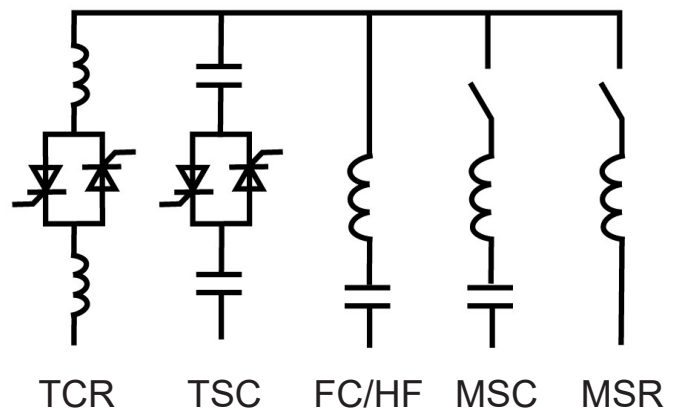
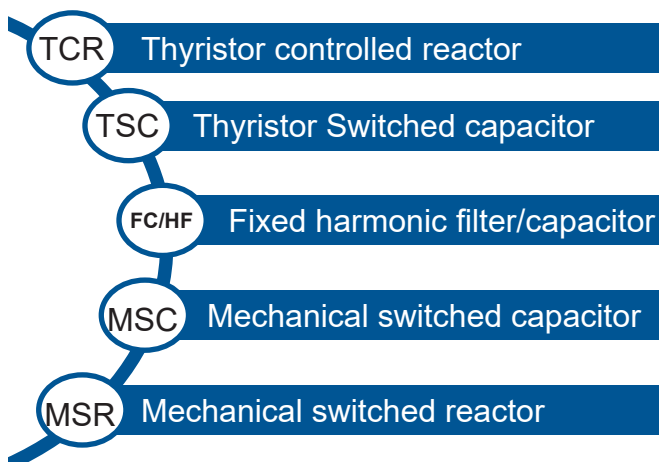
An SVC is connected to the system as shown in the following figure. The capacitor banks provide the reactive power. The thyristor-controlled reactor (TCR) will consume the reactive power that the load doesn't require. This is accomplished by controlling the triggering angle of the thyristors. The control system determines the reactive power compensation required by comparing the reactive power of the bus against the reactive power target value in the SVC controls.



SVC Topology

SVCs are used mainly to control reactive power. The system is a shunt connected VAR source whose output is dynamically adjusted to deliver reactive or inductive current to the system.

The VAR source may vary so we can have multiple configurations:



Technology

Main Components



Thyristor Valves

High power, Thyristor based, series converting technology. Electrically-Triggered Thyristor (ETT) or Light-Triggered Thyristor (LTT) options are available.

Can be connected from 1kv-69kv system directly without step-up transformer.



TCR Reactors

Dual winding, air-core, and natural cooled.

Our air-core reactors are highly reliable and require little maintenance.



Harmonic Filters/Capacitor Banks

Designed specifically to comply the customer needs, we use high quality components, engineered and assembled to provide optimal performance and unparalleled reliability.



Water Cooling System

Compact and high efficiency cooling system.

Two options for cooling are available. Water/water with external loops or water/air type with extra fans.



Protection and Control

Advanced digital control system with multiple customizable functions. Protection modules can be personalized to fit specific customer requirements.

Remote monitoring systems are available.

Technology

SVC Capabilities

Power

50-300 MVAR

Type

Indoor (electrical room)

Thyristor valve

ETT (Electrically-triggered thyristor)

LTT (Light-triggered thyristor)

Voltage

13.2-69 kV

Topology

TCR and/or

TSC

MSC

HF

MSC

Cooling

Air - Water

Water - Water



FACTS Comparison

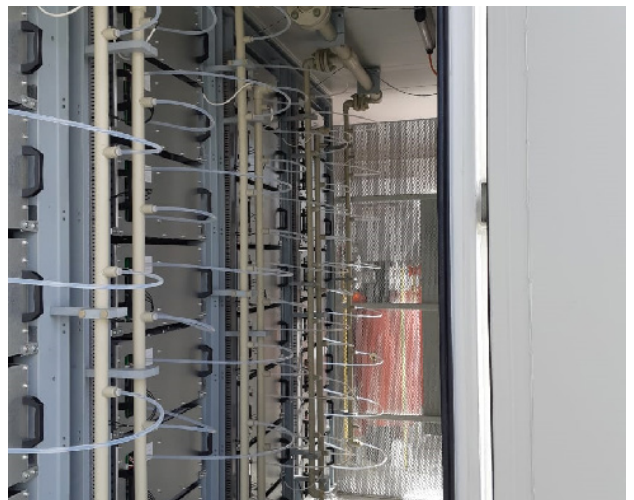
STATCOM is a newer technology than SVC, because of its advantages and versatility, it is replacing SVC as the main power quality and reactive compensation solution.

	SVC	STATCOM
Main Component	Thyristor	IGBT
Response Time	<10 ms	<5 ms
Harmonics	Generates, specially 2nd	Little
Harmonic Filtering	Passive, only if HF are added	Active harmonic filtering
Footprint	Large	20-50% SVC
Losses	1%	06-0.8%
Cost	>80 Mvar lower than STATCOM*	≤80 Mvar lower than SVC*

*Note: Hybrid STATCOMs (SVG + Harmonic Filters) may have cost benefits versus SVC for larger ratings. This is especially true for applications with very asymmetrical VAR output requirements.



SVC



STATCOM

Case Study



Summary:

Industry: Steel

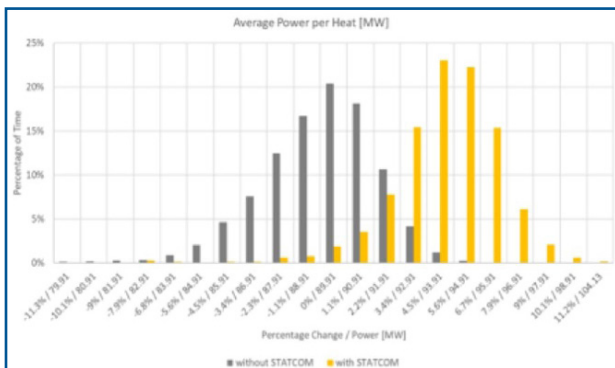
Load: 2 x 120 MVA Transformer for Electric Arc Furnace

Objective: Comply new grid code requirements

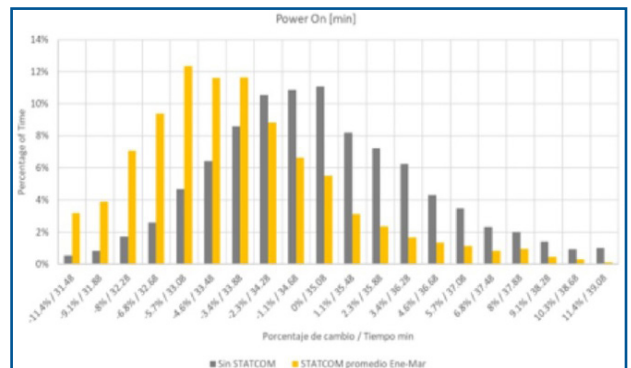
Solution: Replace fixed harmonic filters with 2x160 Mvar STATCOM solution

Results:

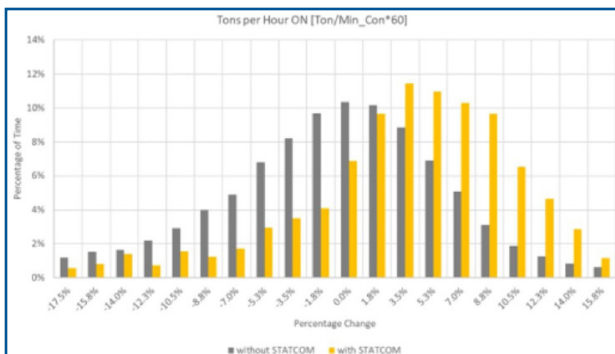
Although the main objective was to comply grid code power factor and power quality requirements, we obtained substantial productivity benefits.



6% Power Increment



5% Power ON reduction time



6.5%
Production Increment

Experience

Our experience applying systems in every industry enables Southern States to meet our customer's specific needs.



Mining
6 MVAR STATCOM



Galvanized steel
4 MVAR STATCOM



Rolling mill
15 MVAR STATCOM



Steel (EAF)
320 MVAR STATCOM



Steel (EAF)
120 MVAR STATCOM



Steel (EAF)
40 MVAR STATCOM



Automotive
4 MVAR STATCOM



Steel (EAF)
75 MVAR SVC



Steel (EAF)
110 MVAR SVC

