Empowering the future

Upgrading outdated SVC with advanced STATCOM

Southern States

Power Systems Solutions

Introduction

Many heavy industrial facilities have traditionally relied on Static Var Compensators (SVCs) as the primary technology for power quality improvement and reactive power compensation. However, with advancements in power electronics, STATCOMs (Static Synchronous Compensators) have emerged as a more efficient and flexible solution across various industries.

Many existing power systems currently operate with SVCs that require upgrades due to increasing power demands, aging equipment, reduced performance, or challenges in sourcing replacement parts.

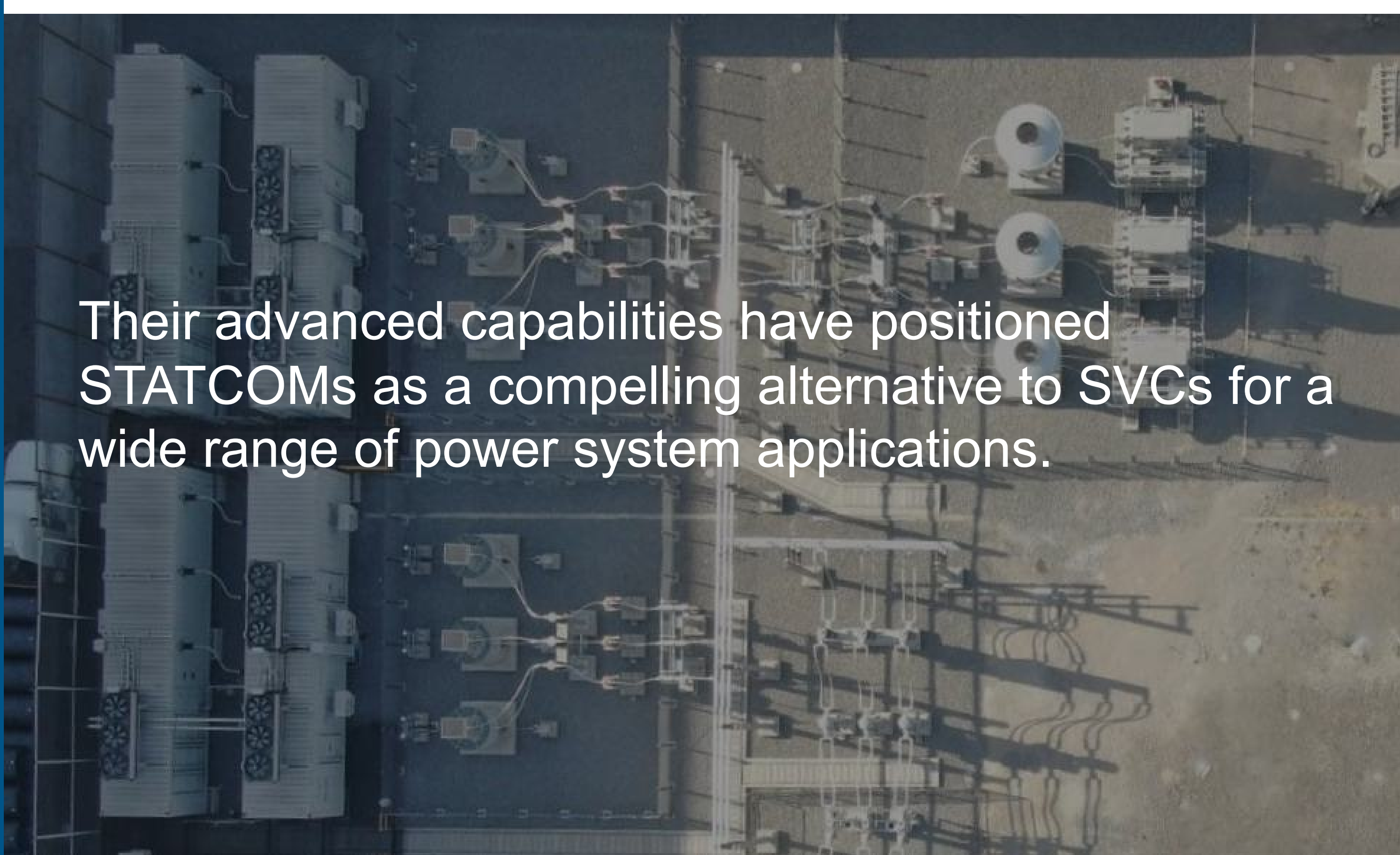
This document compares the two most viable upgrade options—SVC and STATCOM—and outlines the key advantages of replacing obsolete SVCs with STATCOM technology.

Transitioning Away from SVCs as the Primary Technology for Power Systems

In the past, Static Var Compensators (SVCs) were the preferred technology for reactive power compensation in industrial and transmission applications, primarily because they were the most advanced solution available at the time. They have been widely used for decades and are recognized as a mature and proven technology.

Due to the critical nature of power system operations, some industries and utilities were initially cautious about adopting newer technologies like STATCOMs.

However, STATCOMs have demonstrated their reliability and ability to significantly enhance power system performance, delivering tangible operational and financial benefits across various applications.



Their advanced capabilities have positioned STATCOMs as a compelling alternative to SVCs for a wide range of power system applications.

SVC basic operation in Heavy Industrial loads

The basic operating principle of a Static Var Compensator (SVC) involves the dynamic control and regulation of reactive power in an electrical system.

An SVC typically consists of a set of passive fixed filters and a variable reactor known as a Thyristor-Controlled Reactor (TCR). The TCR adjusts the amount of reactive power absorbed or injected into the system in response to voltage fluctuations and reactive power compensation requirements.

By dynamically varying its impedance, the TCR helps stabilize voltage levels by either absorbing excess reactive power or supplying additional reactive power, enhancing overall system performance.

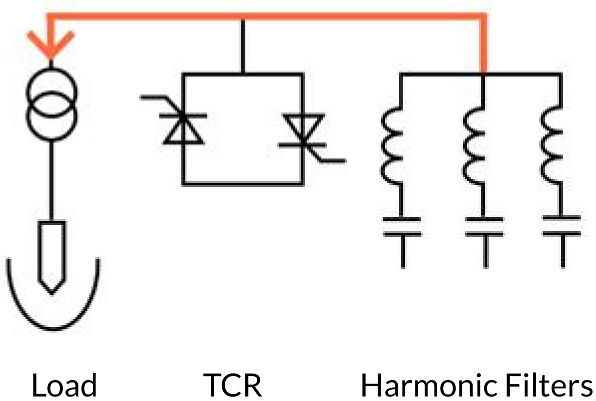


Figure 1. Reactive power supplied to the load

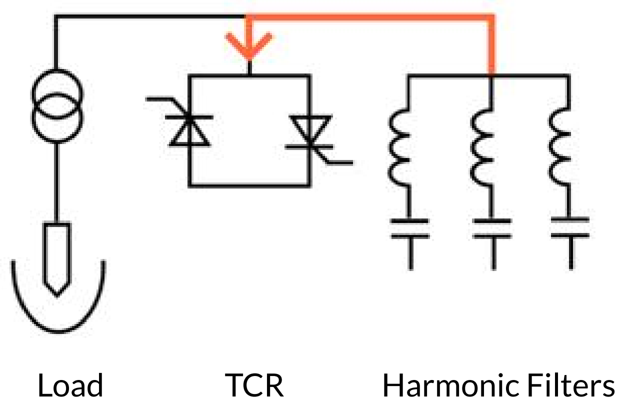


Figure 2. Reactive power absorbed by the TCR

The passive filters are designed to attenuate harmonic distortions caused by non-linear loads, thereby improving power quality. Together, these components enable the SVC to regulate voltage, enhance power factor, and mitigate harmonic disturbances, ensuring stable and efficient operation of the electrical system.

SVCs limitations

One key limitation of SVCs is their **limited speed of response** in addressing sudden changes in load conditions. This can lead to suboptimal voltage regulation, which, in turn, adversely affects system stability, impacting energy efficiency and increasing equipment stress.

Furthermore, SVCs are limited to providing **only passive harmonic filtering,** which may pose challenges in adequately mitigating certain harmonics prevalent in industrial and transmission applications. Notably, SVCs are **unable to filter the second harmonic**, and the operation of the TCR itself can contribute to the generation of harmonics.

These limitations have led to the exploration of alternative technologies like STATCOMs (Static Synchronous Compensators), which offer active harmonic filtering, faster response times, improved voltage regulation, and enhanced system stability, addressing some of the challenges associated with SVCs in various power system applications.

STATCOMs are the new trend in reactive power compensation for dynamic loads.

STATCOMs are emerging as the new trend in regulating dynamic loads across various power system applications. With their advanced power electronics and control capabilities, STATCOMs offer significant advantages over traditional SVCs.

As the adoption of STATCOMs has increased across industries, including mining, steel, and other sectors, a growing number of successful implementations have established them as a reliable and efficient technology for power quality improvement and reactive power compensation.

STATCOM basic operation

The basic operating principle involves the use of advanced power electronics and control techniques to provide precise voltage regulation and reactive power compensation.

A STATCOM consists of a Voltage Source Converter (VSC) that generates a controllable output voltage, typically connected in parallel with the power system.

By injecting or absorbing reactive power through the VSC, the STATCOM regulates system voltage, compensates for reactive power imbalances, and improves power factor.

In many applications, a typical STATCOM configuration often involves a hybrid solution, utilizing a combination of power electronics and passive harmonic filters to optimize costs and serve as a reactive power source.

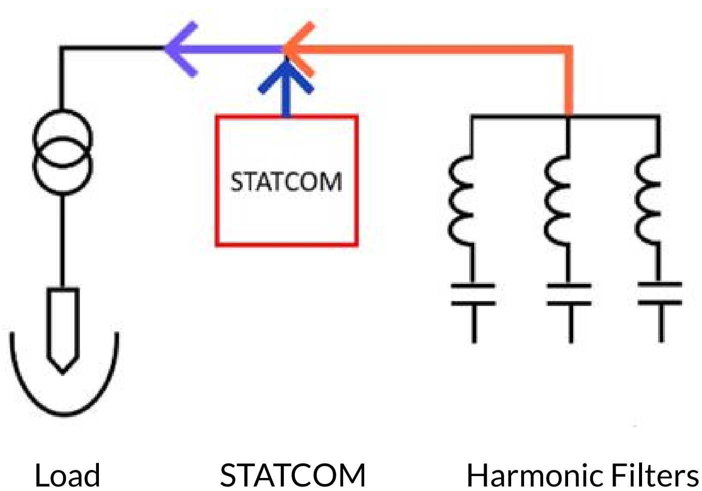


Figure 3. Hybrid STATCOM configuration for EAF applications

The advanced control algorithms of the STATCOM enable fast response times and dynamic control, allowing it to mitigate voltage fluctuations and harmonic distortions in the electrical system.

STATCOMs offers several benefits over SVCs

The STATCOM offers several key benefits over the SVC in industrial applications:

- Faster response time, resulting in improved voltage stability
- Superior harmonic mitigation
- Modular design and flexible hardware for easier power upgrades
- Reduced energy consumption

Opting for a STATCOM as a replacement for an outdated SVC is a smart decision.

Opting for a STATCOM to replace an outdated SVC is a strategic decision, not only due to its numerous technical advantages but also because it has the potential to **reduce capital expenditure (CAPEX)**, **lower operational expenditure (OPEX)**, and require a smaller footprint.

As previously described, the Thyristor-Controlled Reactors (TCRs) used in SVCs are strictly designed for their specific application at the time of installation. These components are large, costly, and lack flexibility to adapt to changing system conditions.

Replacing an SVC with a STATCOM eliminates the need for TCRs, offering a more compact and flexible solution that remains viable for years to come.

Another way to further reduce investment costs is by utilizing the existing harmonic filters from the SVC, provided they are in good condition. At Southern States, we specialize in evaluating and reconditioning equipment when needed, ensuring optimal performance and cost efficiency.

An SVC can potentially be replaced by a significantly smaller STATCOM.

Since the STATCOM has the capability to provide and absorb reactive power, the existing harmonic filters from the SVC being replaced can be utilized as part of the STATCOM system. This results in a significant reduction in the required power electronics for the STATCOM.

Figure 4 provides an example illustrating how an 80 Mvar SVC can potentially be replaced with a 40 Mvar STATCOM, leveraging its reactive power delivery and absorption capabilities.

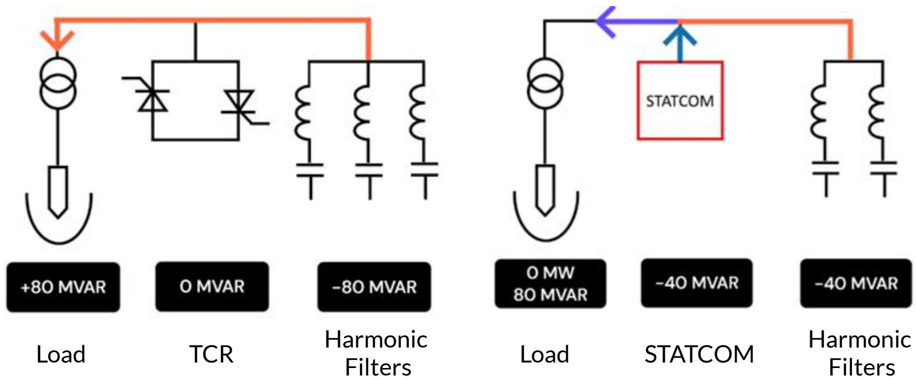


Figure 4. Upgrading 80 Mvar SVC with 40 Mvar STATCOM

Benefits of upgrading outdated SVC to an Advanced STATCOM solution

When opting for a STATCOM solution to replace an outdated SVC, you can gain the following benefits:

Energy efficiency to support sustainability goals: SVCs can consume a significant amount of energy, especially during standby periods. STATCOMs, however, operate with lower losses, contributing to energy efficiency and sustainability initiatives.

Advanced technology: STATCOMs represent the latest and most advanced solution for reactive power compensation, offering superior flexibility and control compared to traditional SVCs.

Superior performance: As previously explained, STATCOMs provide significantly better voltage regulation, faster dynamic response, and improved system stability compared to SVCs.

Lower capital expenditure (CAPEX): STATCOMs' ability to dynamically deliver or absorb reactive power allows for the integration of existing harmonic filters from the SVC (if in good condition), reducing overall investment costs.

Lower operational expenditure (OPEX): With lower energy losses, reduced maintenance requirements, and a smaller footprint, STATCOMs offer a more cost-effective long-term solution than SVCs.

Smaller footprint: STATCOM units typically require only 30-40% of the space occupied by an equivalent SVC, making them ideal for space-constrained installations.

Backup system option: The compact design of STATCOMs often allows for the retention of the existing SVC's TCR as a backup system, ensuring operational continuity if the STATCOM requires maintenance.

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