SVC
Static Var Compensator
The key to better arc furnace economy

Power and productivity
for a better world™

The key to producing more steel...

An electric arc furnace requires a stable and steady voltage supply for optimum performance. An SVC can instantaneously compensate the random variations of reactive power so characteristic of an arc furnace load. The net result is an overall improvement in arc furnace utilisation.

...at a lower cost per tonne...

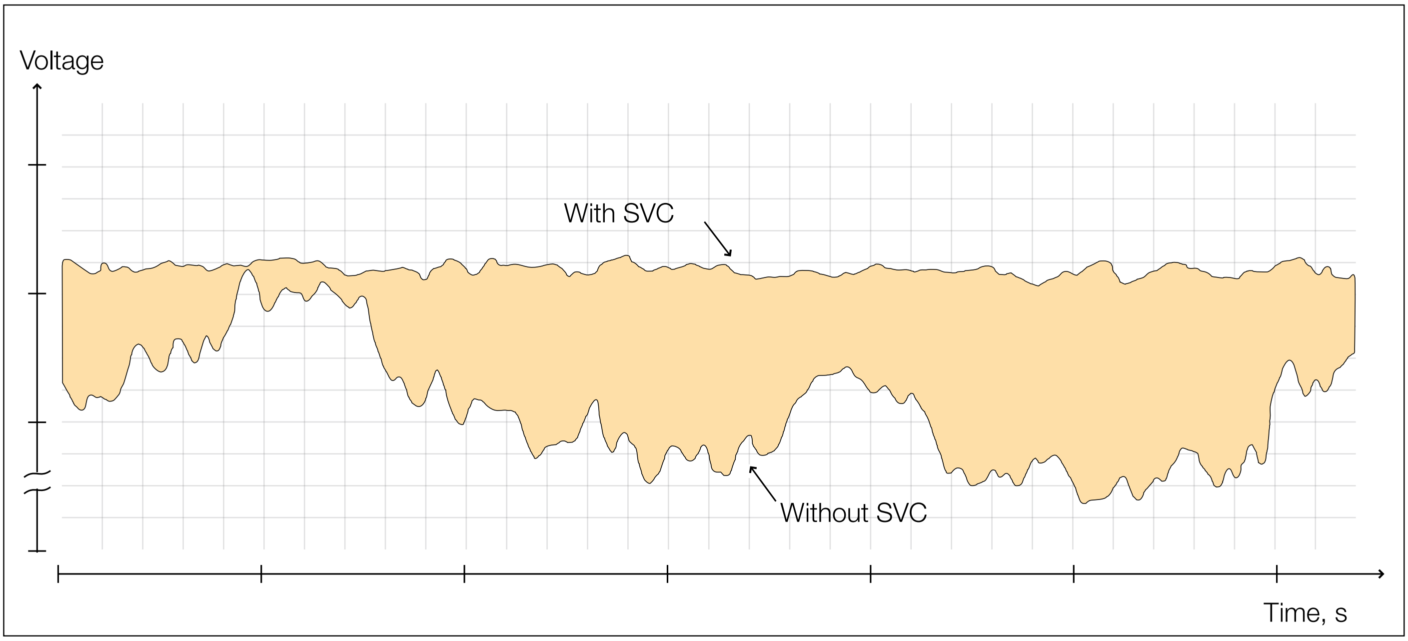
...is a Static Var Compensator (SVC)

Reactive power compensation through an SVC helps you to obtain the following benefits:

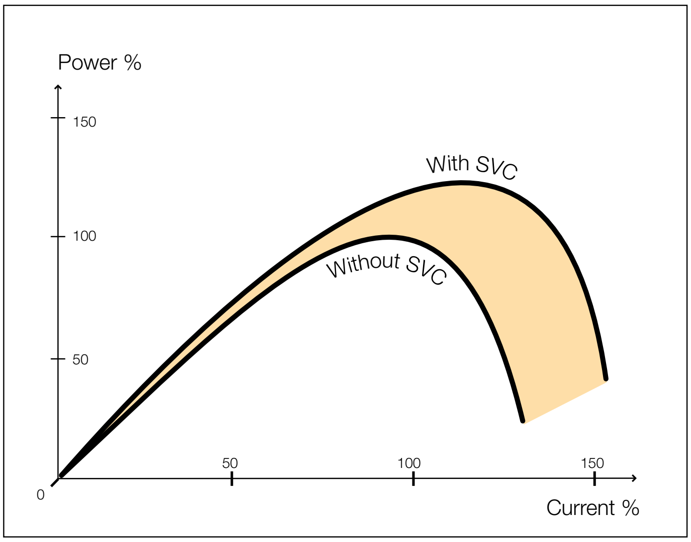
A higher voltage level at the furnace busbar gives:
- shorter meltdown times
- reduced energy losses
- reduced electrode consumption
- extended life of furnace lining

Improved power factor to:
- benefit from lower utility rates
- utilise existing electrical plant more effectively
- lower plant losses

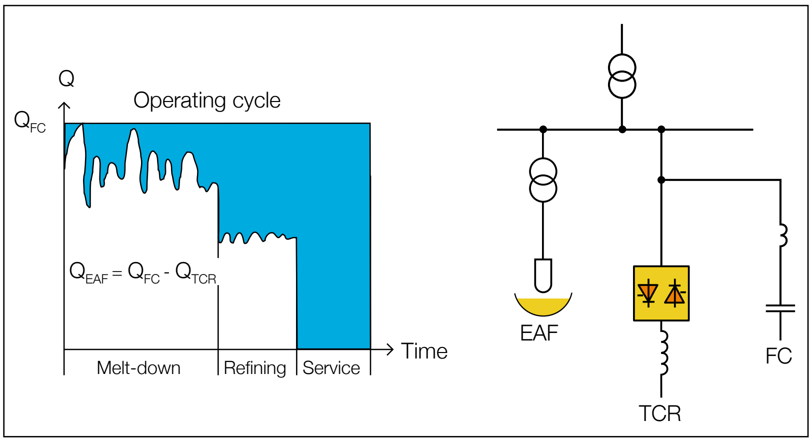
Stabilisation of voltage and reduction of harmonics and phase unbalance to minimise:
- disturbances in nearby electrical equipment as well as in the feeding grid
- maloperation of protection devices
- negative phase sequence currents in motor circuits



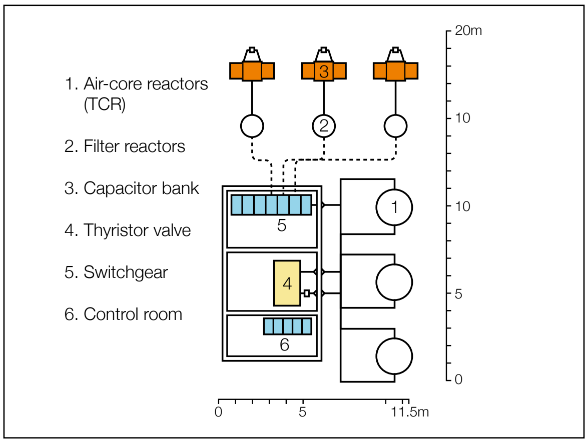
By installing an SVC on the furnace busbar to instantaneously compensate the furnace's large and continuously varying reactive power demand, troublesome voltage drops and fluctuations can be avoided. The mean power input to the arc furnace is raised, and nearby electrical equipment can operate as usual. The curves above show the furnace busbar's voltage with and without SVC.



SVC provides a high and stable bus voltage



Harmonic filters (FC) in combination with a thyristor-controlled reactor (TCR)



Typical layout for an SVC plant

Flexible system build-up enables optimum adaptation to customer needs

An electric arc furnace is a complex and heavy load in a power grid. It is a large, unbalanced, and strongly fluctuating consumer of reactive power.
These reactive power fluctuations which are very marked, especially at the beginning of the melting operation, lead to voltage drops and fluctuations that reduce the active power to the arc furnace and also to other loads connected to the same feeding busbar. The furnace power varies with the square of the feeding voltage and it is thus very important to keep the voltage high and stable. With a Static Var Compensator the reactive power variations are compensated within a few milliseconds and also individually in each phase, providing a balanced and stable voltage.

The reactive power needed by the arc furnace is compensated by a thyristor controlled reactor which in combination with harmonic filters on a cycle-by-cycle basis, produces almost a mirror image of the furnace current.

ABB can offer many features and options so as to provide the optimum solution for each customer.

Examples:

- Direct connection to the busbar that is to be compensated. No need for a stepdown transformer. This is valid for all existing EAF bus voltages up to 69 kV.
- Most often, the Bi-Directional Control Thyristor (BCT) is used. The BCT brings the advantage of locating two thyristors in one housing, enabling more compact design.
- A fully computerized control system. High performance industrial standard buses and fibre optic communication links are utilized.
- The thyristor valves are of indoor type, water-cooled for efficiency and compactness.

Thyristor valve

TCR reactors

Unique experience from the steel industry

– Since 1972, ABB has been supplying Static Var Compensators to arc furnaces in steel mills all over the world.
– We have been involved in design and manufacture of industrial furnaces for almost a century and our metallurgists and engineers are specialists in the metallurgical process and the problems involved in arc furnace applications.
– We have our own research, development and manufacturing facilities for both components and systems.
– We have a world-wide after-sales service organisation and local engineering and manufacturing companies in many countries.

ABB holds the key to the best reactive power compensation solutions. Consult us to find out exactly how much you will benefit by installing a Static Var Compensator – it's usually a very pleasant surprise!

SVC brings power quality in the grid

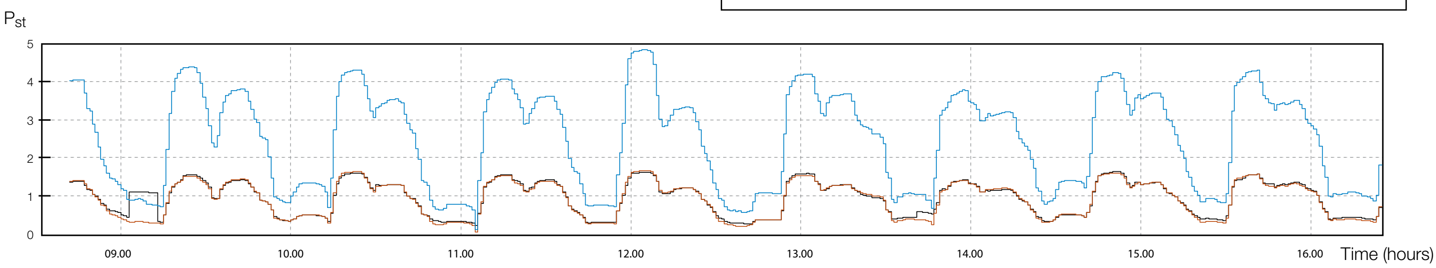
Electric arc furnaces are complex loads on the power supply, which is usually the public grid. During operation, unless proper measures are taken, an EAF causes power quality deratings as follows:

- Voltage fluctuations and flicker;
- Negative-phase sequence components in currents and voltages;
- Harmonics.

An SVC is an efficient means of maintaining power quality in the plant as well as in the feeding grid. The outcome is a winning situation for all:

- Compliance with the power quality standards specified by the grid company.
- Other consumers connected to the common grid are spared the nuisance of disturbances emanating from the steel plant.
- The steel manufacturer can operate the steel plant without infringing on operational agreements with the grid company.

A flicker reduction factor up to 2.5 has been reached with the SVC. In cases where this is not sufficient, ABBs SVC Light® is the answer.



Flicker reduction from a steel plant: an example from real life[1]. **Blue:** flicker level, uncompensated; **Red/black:** flicker level, compensated.

[1] Recording from a 50 MVA EAF taking its power from a weak 110 kV grid.

Cutting production costs

By increasing the active power available to an arc furnace, a Static Var Compensator can cut the meltdown time (T_{md}) by up to 20 %.

T_{md} can be calculated using this formula:

$$T_{md} = \frac{G \times W \times F \times 60}{P}$$

where G = charge weight (tonnes)

W = energy consumption (kWh/tonne)

F = utilisation factor, approx. 0.75

P = furnace power (kW)

As a result of increased active power to the furnace, the reduction in meltdown time will be:

$$\Delta T_{md} = G \times F \times 60 \times \left(\frac{W_1}{P_1} - \frac{W_2}{P_2} \right)$$

where P_1 = furnace power applied, without SVC (kW)

P_2 = furnace power applied, with SVC (kW)

W_1 = energy consumption, without SVC (kWh/tonne)

W_2 = energy consumption, with SVC (kWh/tonne)

Potential benefits

By improving the utilisation of existing plant, not only are operating costs cut, but it will be longer before additional plant needs to be aquired. During periods of low utilisation, overheads can be trimmed by reducing the number of furnaces online, while still achieving the same level of production.

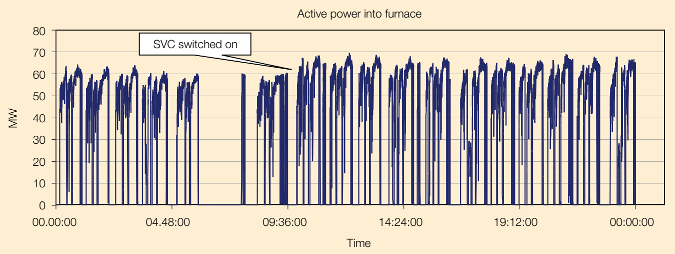
Other benefits

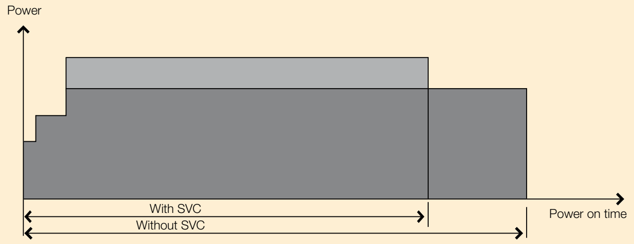
- Reduced electrode consumption
- Reduced energy consumption
- Reduced costs of furnace lining

All in all, SVC pay-back times of a year or even less are attainable in many cases.

A typical example

EAF 75 MVA, 100 T	Without SVC	With SVC	Improvement (%)
SVC (Mvar)	0	90	
Power factor furnace (p.u.)	0.78	0.78	
Power factor supply (p.u.)	0.78	0.99	
Voltage drop (%)	10	0	
Melting power (MW)	50	60	20.0
Energy (kWh/tonne)	430	420	2.4
Melting time (min)	38.7	31.5	22.8
Power on time (min)	56.7	49.5	14.5
Tap-to-tap time (min)	68.7	61.5	11.7
Electrode consumption (kg/tonnes)	1.6	1.55	3.2





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